MINING CONGRESS JOURNAL

JANUARY, 1959

PRESIDENT
American Mining Congress

RAYMOND E. SALVATI

The simple, low cost answer to these coal preparation plant problems...

1. **Recovery of marketable coal fines from washing plant waste**
2. **Removal of solids from washery plant effluent**
3. **Reclamation of water in closed water systems**

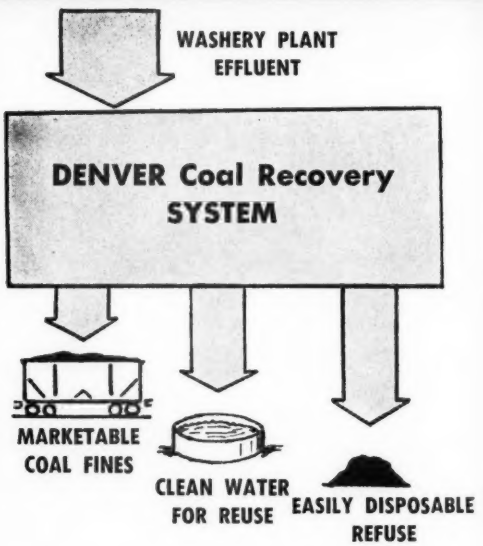
DENVER Coal Recovery SYSTEMS

SIMPLE • EFFICIENT • PROFITABLE

Since more fines are produced in mechanized mining, it is not economical to discard coal fines to waste even though ash contaminants may render these fines unmarketable without additional cleaning. Washeries faced with recovery of clean coal fines, removal of solids from plant water and providing a closed plant water system, now have a simple, low cost answer.

Whether you are confronted with any or all of these problems, DENVER can provide the answer with a simple, low cost system that will recover both coarse and fine, marketable, low ash coal from minus ⅛" down to 200 mesh and finer. A compact system that will reclaim water for reuse in a closed system—one that permits disposal of high ash washery waste without stream contamination—efficiently and profitably.

- **DENVER offers over 30 years of experience in designing and supplying coal washery plant systems. A complete service from testing to flow-sheet to equipment, installation and to profits. One source—one responsibility.**

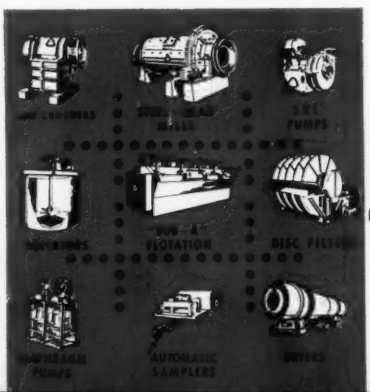


DENVER *offers one source for* COMPLETE SYSTEMS, INDIVIDUAL COMPONENTS

DENVER EQUIPMENT CO.
1400 17th St.
Denver 17, Colorado

Please send details of your complete system and service for handling coal washery effluent.

Name_____
Title_____
Company_____
Address_____
City_____ State_____



"The firm that makes its friends happier, healthier and wealthier"

DECO ENGINEERS — STANDARD RELIABLE 24 HOUR SERVICE EFFICIENT

DENVER EQUIPMENT COMPANY

Cable DECO DENVER
Phone CHerry 4-4466
1400 Seventeenth St.
Denver 17, Colorado

MINING CONGRESS JOURNAL

VOL. 45 JANUARY 1959 NO. 1

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Opinions expressed by the authors within these pages are their own and do not necessarily represent those of the American Mining Congress.

ARTICLES

SPECIAL REPORTS

DEPARTMENTS

ON OUR COVER

The American Mining Congress welcomes its new President, Raymond E. Salvati, President, Island Creek Coal Company. For story on the Annual Membership Meeting, see pages 21-24.

Published Monthly. Yearly subscriptions, United States, Canada, Central and South America, $3.00. Foreign, $10.00. Single copies, $0.75. February Annual Review Issue, $1.25. Second class postage paid at Washington D. C.

mines the highwall

average–535 tons per 8-hour shift

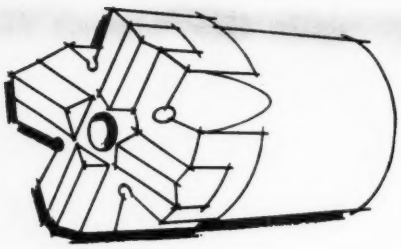
REMARKABLE PRODUCTION is reported by users of the Jeffrey Colmol... in so many types of coal mining operations. In a new highwall mining operation, for instance – Colmol delivers an average of 535 tons per 8-hour shift. Ten minutes after cutters attack the face, the Colmol has dug its way out of sight.

The Jeffrey Colmol requires minimum maneuvering and manipulation of controls... handles easily on its long, wide crawlers... turns in its own length. It faces up to the most severe mining conditions, operates with little noise or vibration. Coal is *broken* from the face... *not ripped or ground off*. You get better overall consist, greater speed and efficiency with a Colmol.

In seams as low as 28"... or as high as 96" Jeffrey Colmols step up your production rate, cut operating costs. Write for complete details. The Jeffrey Manufacturing Company, 958 North Fourth Street, Columbus 16, Ohio.

JEFFREY

...TRANSMISSION MACHINERY...CONTRACT MANUFACTURING



Removable

yet

New air-leg bit cuts your drilling costs 5 ways!

IT'S *removable* to save time and money — yet the new Timken® tapered socket bit for air leg drills has *one-piece strength.* The union is tapered! Now, for the first time, you can get the strength of one-piece bits plus these five cost-cutting advantages of removability that intraset steels can't give you:

1. No need to throw away good drill steel when the carbides wear out. With intrasets you have to waste perfectly good steels.

2. A pocketful of bits is enough for a day's work. You haul an armful of steel with intrasets.

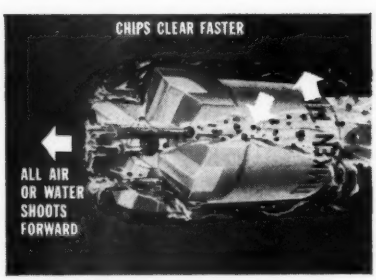
3. You can change bit gauge sizes fast on the same steel. Using intrasets you have to change the whole steel.

4. You carry only the bit to the shop for resharpening. With intrasets you lug the whole steel.

5. You get longer gauge wear because there are *four* carbide cutting edges. Most intrasets have only two.

Notice at right how the new frontal design of the Timken tapered bit clears chips faster for extra savings. And new, special-analysis carbide inserts give superior wear-resistance, added shock-resistance. They can be reconditioned many times.

Get *all* these savings. Switch to the new Timken tapered bit. For free brochure write: The Timken Roller Bearing Company, Rock Bit Division, Canton 6, Ohio. Cable address: "TIMROSCO". Makers of Tapered Roller Bearings, Fine Alloy Steels and Removable Rock Bits.

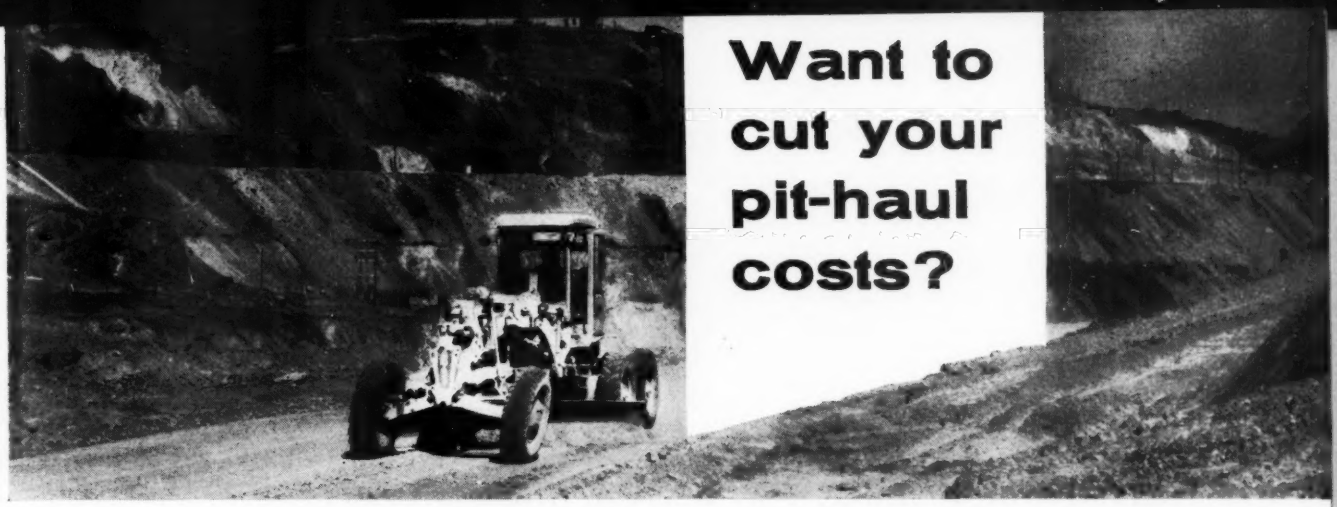


CHIPS CLEAR FASTER because 1) five front holes shoot water or air directly against the rock face and 2) deeper, wider wing clearance lets chips wash back faster.

TIMKEN®

AVAILABLE NOW!

THE AIR-LEG BIT OF THE FUTURE



Want to cut your pit-haul costs?

How 15-speed "blade" can help your haulers make extra pit-to-plant trips every day

You'll reduce the per-ton cost of hauling, boost pit output every day, by traveling your haulers at higher speed. Faster haul speeds are practical *only* when your pit floor, benches, and haul roads are kept clean, smooth, and well drained. The better your surface, the faster you haul . . . the more trips per day, the lower your pit-haul costs.

To keep your haul routes in tip-top shape you need graders that can do maximum work. You need machines that can make heavier cuts, push bigger loads, work and travel faster . . . machines that can always work your tough materials at, or near, full power. This requires a wider range, and more selective gear-ratios than most graders afford.

More speeds for full-power work

Only Adams* 80 to 150 hp graders give you the extra work-speeds you need. They provide 8 standard speeds forward and 4 reverse, plus 3 creeper gears (opt.) . . . that's 15 speeds in constant-mesh transmission.

For building and maintaining haul roads, ditching, and clean-up at pit, plant, and stockpile, Adams gives you 4 efficient forward working speeds. Other graders with 6 forward speeds have only 3 working gears . . . often cannot develop full push-power at the faster speeds that are "just right" for the job.

Adams' 2 intermediate gears, 10 and 14 mph, are handy for light, fast blading, snow plowing, maneuvering and climbing tough grades. And travel speeds to 26 mph save time between grading assignments . . . time that can be used for extra blade-work.

Up to 30% more push-cycles on one-way grading

Most graders have only 2 reverse gears . . . about 3 and 7 mph. Adams has 4 reverse speeds — 2 for working, 2 for high-speed back-up. Adams' top reverse speeds (8 and 13 mph) pay big dividends. Often your operator works a 200′ to 400′ stretch, or even more, that is too short or too confined to make turning-around worthwhile. Instead, he backs-up. The Adams makes the reverse trip fast . . . converts usually wasted travel-time to extra blade-work.

Creeper gears for added "muscle", precise control of grade

Three optional creeper speeds, 31′ to 160′ per min. (full power, 0.41 to 1.82 mph), afford a means to concentrate full engine-power for ripping-up and regrading old roadways, pioneering for exploration and new roads, clearing overburden of stumps and roots and working thru rocky ground. They eliminate the costly common practice of "slipping the clutch" at high rpm to get maximum power at slow speed . . . reduce shock and clutch wear. Creepers also help you cut more accurate grades, and work in tight places.

190 hp POWER-*Flow** 660

For maximum push-power *at all speeds*, Adams POWER-*Flow* Model 660 with torque converter gives you the effective work-power of an *infinite* number of gear ratios, from 0.0 mph to 27.4 mph forward.

Any one of the 7 Adams graders — 190, 160, 135, 123, 115, 85, and 60 hp — will handle more work per $ investment. There is a size to fit your grading problems in any type of pit-plant situation. In any size, Adams will keep your haul routes smoother than can similar competitive machines. Call us for details.

Adams graders can handle more of your type of jobs, save time and money with efficient interchangeable attachments. These include: *Scarifier* for ripping-up old roadways and rock-filled soil, *bulldozer* for spreading and casting dirt and road materials, *snow equipment* for clearing roads, *push-plate* for push-loading scrapers and starting balky haulers.

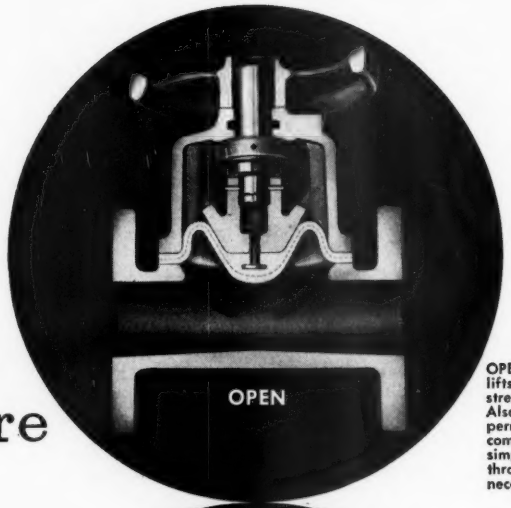
*Trademark G-1626-MQ-1

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

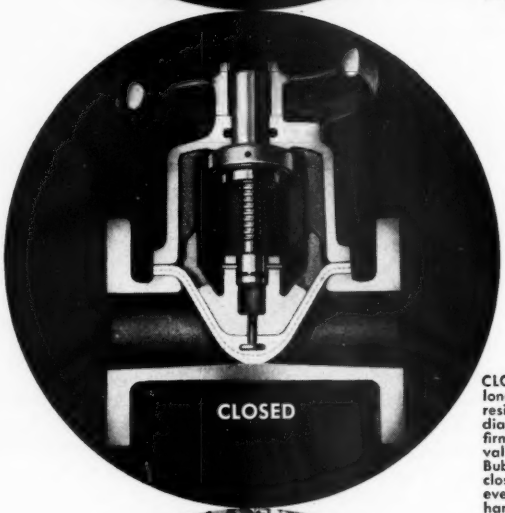
A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

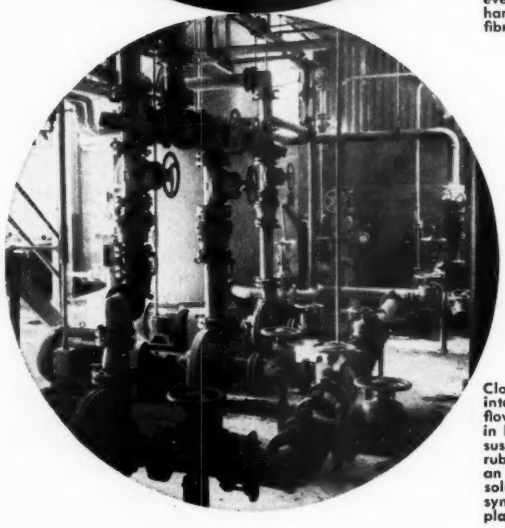
Maximum flow, minimum turbulence, negligible pressure drop!



OPEN Diaphragm lifts high for streamline flow. Also, valve design permits comparatively simple rodding through, when necessary.



CLOSED Despite long usage, resilient diaphragm seals firmly against valve body. Bubble-tight closure is assured, even when handling gritty or fibrous materials.



Clogging and interruption to flow is prevented in lines handling a suspension of rubber particles in an acid brine solution at this synthetic rubber plant.

GRINNELL-SAUNDERS STRAIGHTWAY DIAPHRAGM VALVES* are unsurpassed for handling viscous materials — semifluid foods, latex, magmas; solids in suspension — slurries, pulp stock, sludges; fluid-borne abrasives; corrosive chemicals.

The straight-through design eliminates pockets, gate trenches and other obstructions which can trap solids. The result is maximum flow, minimum turbulence, and negligible pressure drop for a diaphragm valve.

The straight-through design also has the advantage of causing very little basic change in the direction of the fluid stream, thus reducing abrasive action from high velocity particles.

These advantages are in addition, of course, to benefits normally associated with the use of diaphragm valves . . . such as freedom from corrosion and clogging of working parts, since these are completely sealed off by the diaphragm; prevention of product contamination; elimination of stem leakage and routine maintenance, because there are no packing glands. Also, when properly pitched, lines are self-draining.

Grinnell-Saunders Straightway Diaphragm Valves are available in a choice of body sizes and materials, linings and diaphragms. Handwheel or power operated. For complete information, write Grinnell Company, Inc., 277 West Exchange St., Prov. 1, R. I.

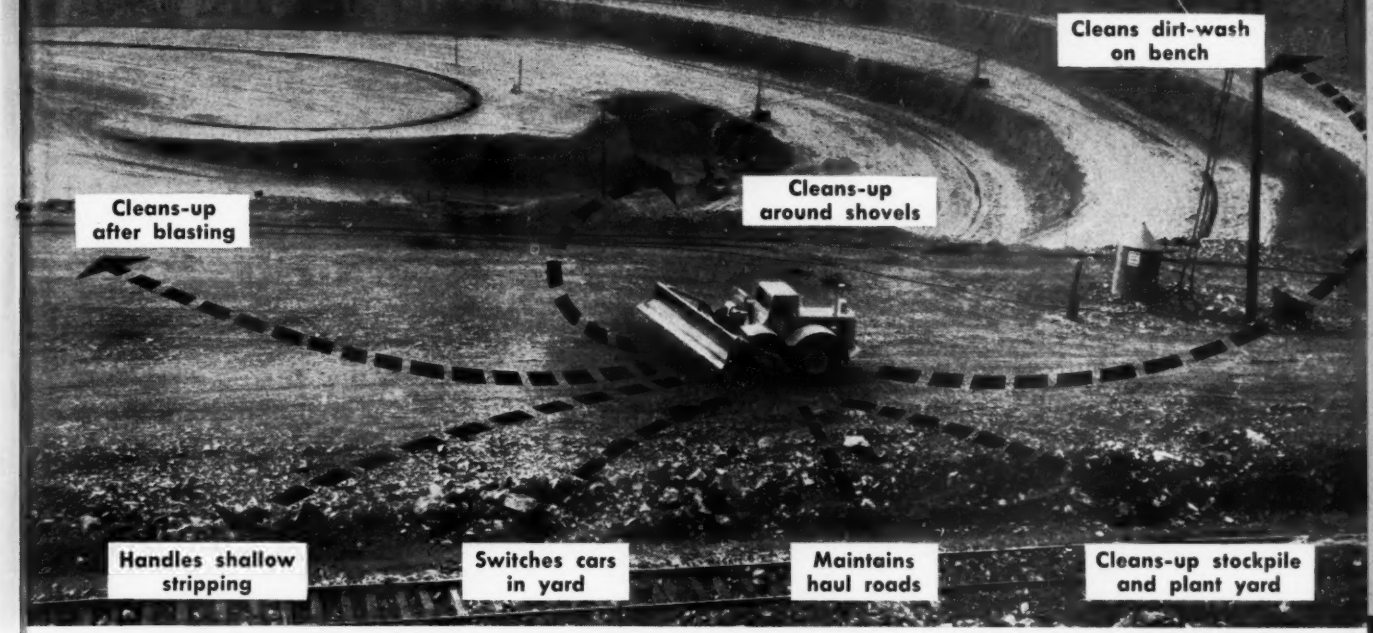
*Patented

GRINNELL-SAUNDERS DIAPHRAGM VALVES

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

Can ONE tractor keep up with your scattered maintenance assignments?



Tournatractor with Angledozer® blade uses its 17 mph speed and rubber-tired mobility to handle wide variety of assignments at a large open-pit copper mine in Arizona.

To meet stepped-up production demands, it will pay you to consider a mobile, rubber-tired tractor — one that can efficiently and economically handle your increased clean-up work over larger pit areas. You can save time and money with a mobile tractor-on-rubber that can speed directly to each new assignment, on or off haul roads.

LeTourneau-Westinghouse Tournatractor® — with its wide, low-pressure tires that let you travel anywhere over haul roads, rocky pit floors, RR tracks, ties, switches, and air-drill hose lines — has these capabilities.

Work-and-run mobility

Since this 17 mph tractor can travel 2 to 3 times faster than a crawler, it gives you a major speed advantage when traveling between clean-up assignments around scattered shovels. Tournatractor's speed also increases its versatility, so that it can be used as a multi-purpose tool, to economically handle many types of assignments.

You can use Tournatractor to clean around 2 or more shovels . . . to maintain stockpiles, level waste dumps, clean debris off RR tracks . . . to clean benches, handle shallow stripping, switch cars . . . to pull air-compressors, supply and service wagons on sleds. With this rubber-tired tractor, there are no delays for crawling travel, or for load-and-haul to new location. You can even use it for maintenance and clean-up in one or more adjoining pits.

Many owners report the costs of maintaining Tournatractors to be only *one-fourth* to *one-half* the cost of crawler maintenance. Main reason is that you have only 4 wheels and tires to maintain and replace — instead of the more than 500 moving, wearing track parts on a crawler. Tires flex over rocky floors — do not concentrate loads that break track links. Also, this rubber-tired tractor has less lube points, to cut daily lubrication time to less than one-half that required for a crawler-tractor.

Ask for a demonstration on your job

When analyzing your equipment needs, look into Tournatractor's exceptional work-and-run ability for clean-up work in your pits. Let us give you more information, or ask for a demonstration in your pit, and see what this rubber-tired tractor can do!

Fast clean-up of big chunk rock around shovel is handled by Tournatractor for the Ruberoid Co., near Lowell, Vermont. Tractor dozes at about 8.3 mph, and reverses at 7.2 mph.

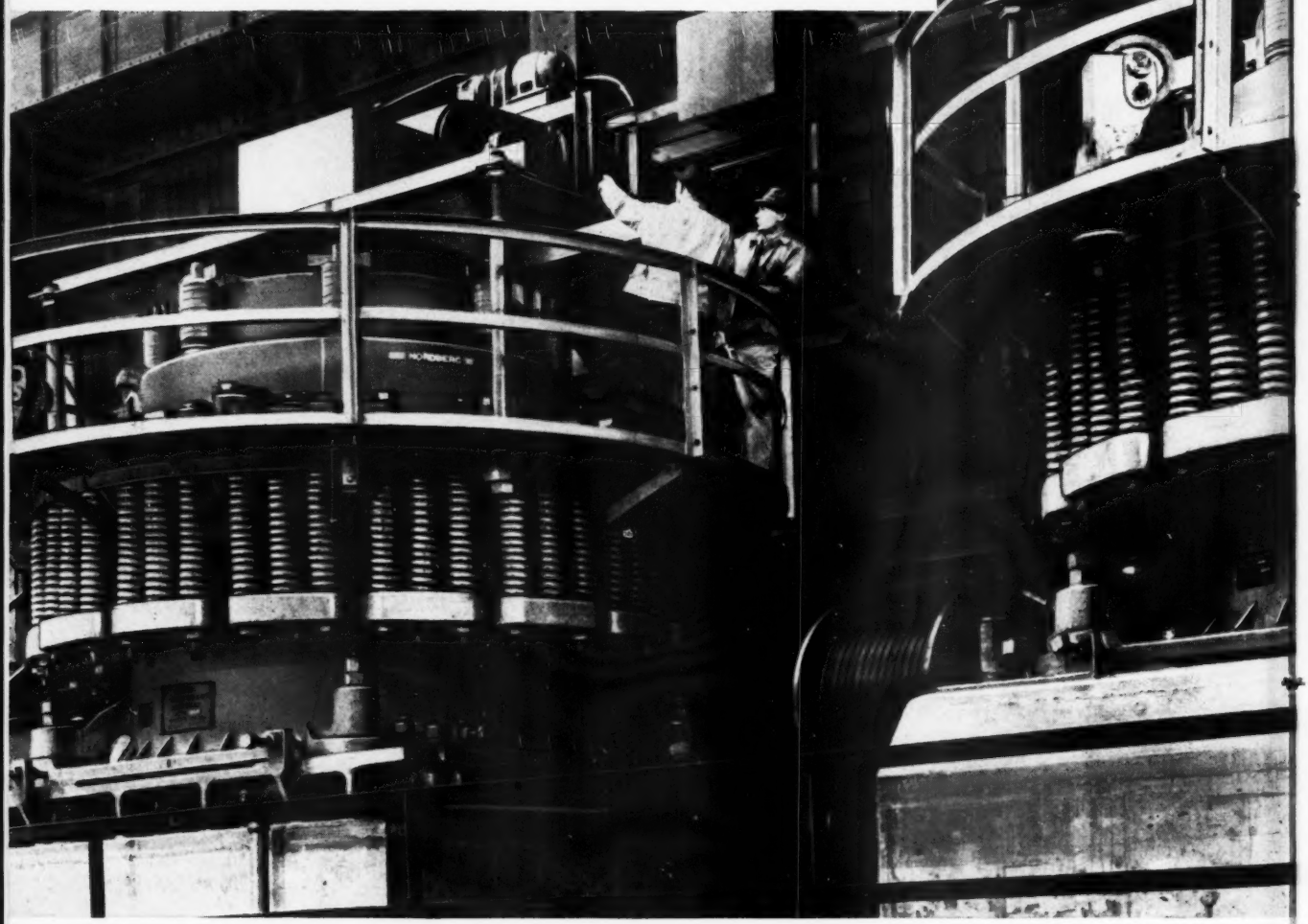
Equipped with type "E" railroad coupler, versatile Tournatractor here serves as a Switch-Tractor* . . . spots rail cars when not working on dozing chores for southern uranium mine. SwitchTractor can move 5 loaded or 18 empty cars up a 1% grade. *Trademark CT-1727-M-1

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

Lower Ton-Hour Crushing Cost



with SYMONS® CONE CRUSHERS

Here are some of the reasons why:

You can get up to 900 or more tons per hour per unit . . . Symons Cone Crushers consistently deliver large tonnages of crushed product. Positive setting and a carefully designed crushing cavity assures uniformity of product.

Operate with minimum supervision . . . Symons Cone Crushers require a minimum of man hours for installation, operation and maintenance. Adjustments for product size or liner wear are quickly made, and easy access to all parts makes servicing relatively easy and holds down-time to a minimum.

Ability to withstand rugged service . . . Symons Cones are of heavy duty, quality construction to meet the extremely tough service encountered in reduction crushing of all types of ores and minerals. All bearings are thoroughly lubricated by a pressure circulating system.

Full size range for primary, secondary or tertiary crushing . . . Symons Cone Crushers are built in eleven different sizes, ranging from 22″ to 7′ in diameter, for capacities of from 6 to 900 or more tons per hour. Available with fine, medium, coarse and extra-coarse cavities, to take feed up to 18″ or 20″. *For complete details, send for Bulletin 247.*

SYMONS . . . a registered Nordberg trademark known throughout the world.

NORDBERG MFG. CO.,
Milwaukee 1, Wisconsin

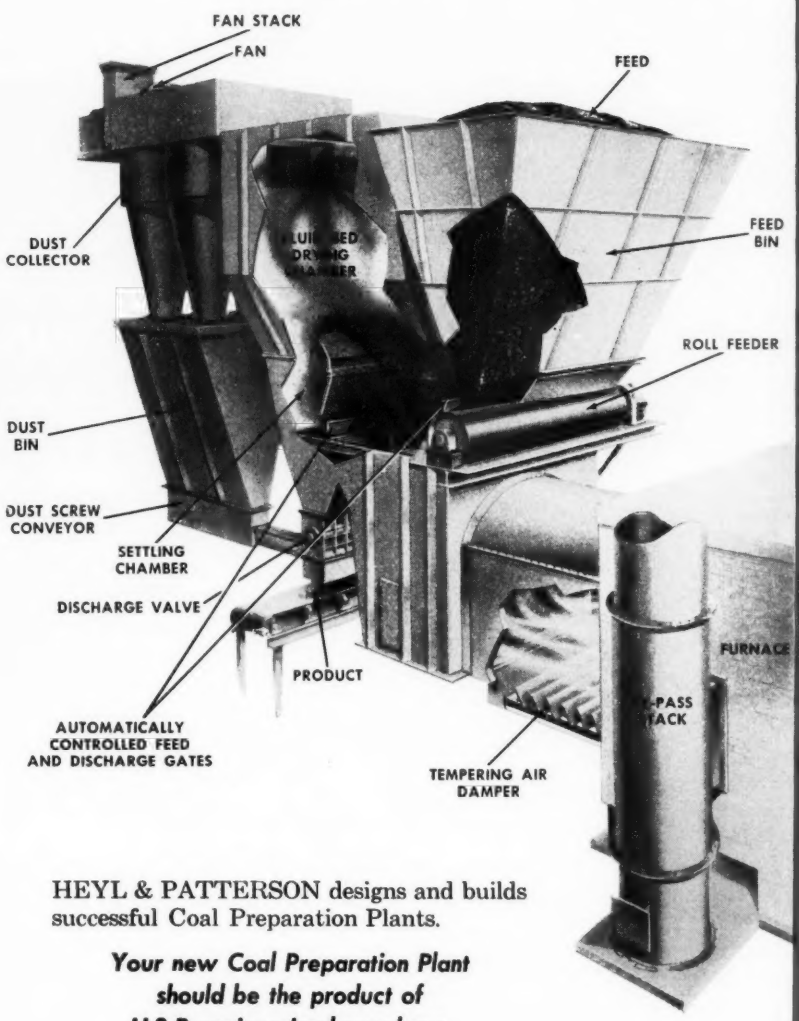
NORDBERG

C658

ATLANTA • CLEVELAND • DALLAS • DULUTH • HOUSTON • KANSAS CITY • MINNEAPOLIS • NEW ORLEANS • NEW YORK • ST. LOUIS
SAN FRANCISCO • TAMPA • WASHINGTON • TORONTO • VANCOUVER • GENEVA • JOHANNESBURG • LONDON • MEXICO, D. F.

The H & P Fluid Bed Dryer

at Westmoreland Coal Company's Hampton #3 . . .



represents the first commercial application of FLUIDIZED THERMAL DRYING specifically designed for The Coal Industry. 4 more H & P Fluid Bed Dryers, each twice or three times as large, are now being constructed for Westmoreland and other Coal Companies.

Westmoreland Coal Has Experienced These Advantages:

1. Maintenance during nine full months of operation has been negligible.
2. The Dryer has consistently handled larger tonnages and evaporated more water than was expected.
3. Laboratory checks of size consists show that the dried product is the same size as the feed.
4. The design is so simple that an operator with little previous experience can be placed at the controls.

HEYL & PATTERSON designs and builds successful Coal Preparation Plants.

Your new Coal Preparation Plant should be the product of H & P engineering know-how.

Take advantage of this experience and phone COurt 1-0750.

Heyl & Patterson INC.

88 FORT PITT BLVD., PITTSBURGH 22, PA., COurt 1-0750

Write for these brochures:

159—H & P Fluid Bed Dryer
557—Coal Preparation Plants
1157—H & P Cyclones
558—H & P Sieve Bend
247—H & P Bradford Breaker
557-R—Reineveld Fine Coal Dryer

These engine users profit

from Allis-Chalmers economy of operation...

"Performing perfectly . . . no maintenance"

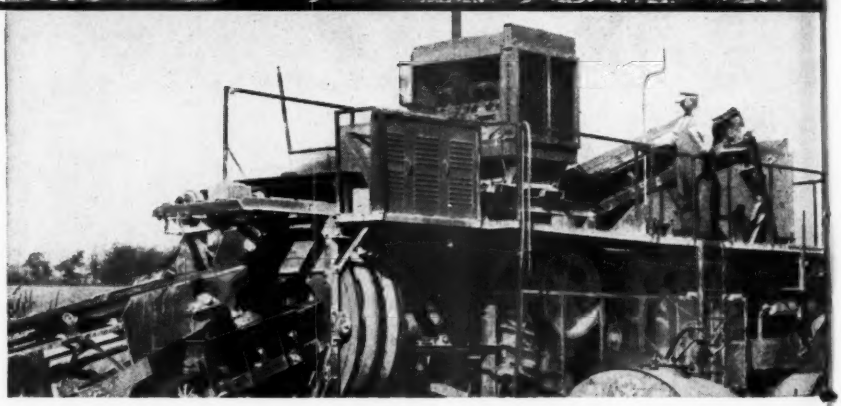
This 3-yd shovel, powered by an Allis-Chalmers supercharged diesel with torque converter, is working in tough digging, removing shot rock on an interstate highway. The engine uses only 10 gal. of fuel per hour, "is performing perfectly . . . no maintenance of any kind has been required," says the owner.

Helps hold down cost of moving overburden

Performance of big, tough, Allis-Chalmers supercharged diesels in these 55-ton trucks, has helped hold hauling costs down to a surprisingly low level.

"Like it best of any engine we've had"

"Wish we had one on the shovel," says the job superintendent about the Allis-Chalmers 180-hp diesel powering this crusher. The owner of another of these engines reports, "It's the cheapest of all to operate!"



...you can, too!

Allis-Chalmers engines give you maximum work per operating dollar. Design simplicity means easier servicing, too. Allis-Chalmers engines are always on the job because you are close to fast parts and service, wherever you are. See your dealer for full information on these engines that save you money — up to 516 hp — any application. Allis-Chalmers, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

***POWER* FOR A GROWING WORLD**

BC-19A

USERS OF **NEW**
ROEBLING HERRINGBONE* WIRE ROPE
HOLD THESE TRUTHS TO BE SELF-EVIDENT...

That Herringbone is the most practical and *needed* wire rope development to come along in years.

Herringbone, the regular lay and Lang lay rope, is actually two-ropes-in-one rope. Thus, the qualities that make these two ropes *good* ropes, combine to make Herringbone *excellent.*

HERE'S WHY:

The steel core of Herringbone provides the *ideal* support for the two pairs of Lang lay and one pair of regular lay strands used in its construction. In addition, the outer wires are heavier for extra abrasion resistance, and good flexibility is maintained by the finer wires inside. This combination of features enables Herringbone to give *longer service* in most applications.

Herringbone has been used on a wide variety of excavating equipment and tough hoisting jobs with impressive results. Its applications are practically unlimited on installations which call for all-steel ropes and on many where fiber core ropes are now being used. Another of Herringbone's added attractions is the fact that it eliminates the necessity for stocking Lang lay rope for one job and regular lay for another.

Your Roebling Distributor has Herringbone right now. He has, also, copies of a brochure describing Herringbone, the newest Roebling Star Performer. If you wish, write Wire Rope Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey, for literature and anything you'd like to know about Herringbone.

*Reg. App. For

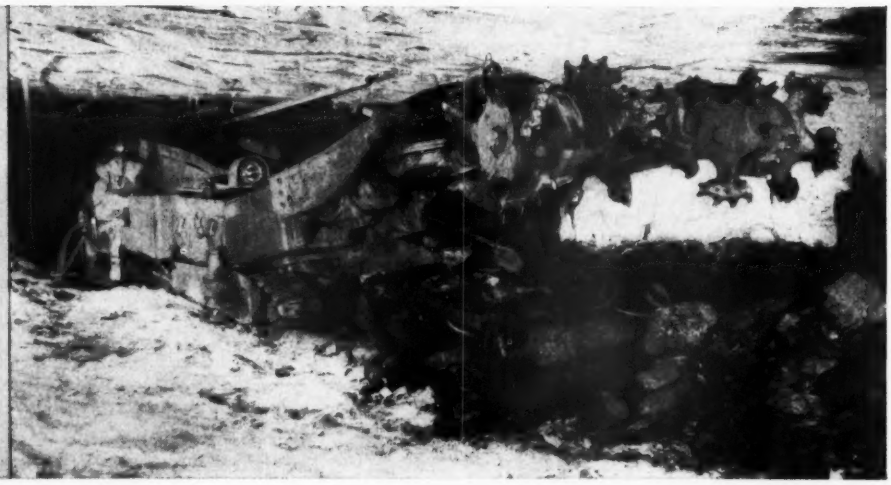
ROEBLING

Branch Offices in Principal Cities
Subsidiary of The Colorado Fuel and Iron Corporation

HERRINGBONE
WIRE ROPE

More tonnage . . . more profits

50% Higher Tonnage with the *new* CM37



For medium and high seams

Backed by the tried and proven cutting principle of the original Lee-Norse Miners, the CM37 brings a new high in operational efficiency to continuous mining. This rugged machine has more power, more capacity and higher tramming speed that results in increased tonnage per man shift.

Check these NEW FEATURES!

1. Total weight 25 tons—a 25% increase! Extra weight mostly in improved cutter head where it does the most good!
2. More power—fewer motors! Only 3 identical electric motors used . . . conservative continuous ratings . . . no water cooling.
3. Heavy duty electric control.
4. 14" wide crawler treads with improved hydraulic motor and gearing.
5. 24" wide conveyor driven by hydraulic gear motors applied directly to gathering head. Hydraulic start and stop . . . no clutch required.
6. Multiple tramming speeds—variable speeds to 50 feet per minute . . . fast tramming at 90-100 feet per minute.
7. Increased capacity...4 to 5 TONS PER MINUTE.

Coal high or low? . . .

. . . with Lee-Norse MINERS

For Low Coal . . .

LCM28

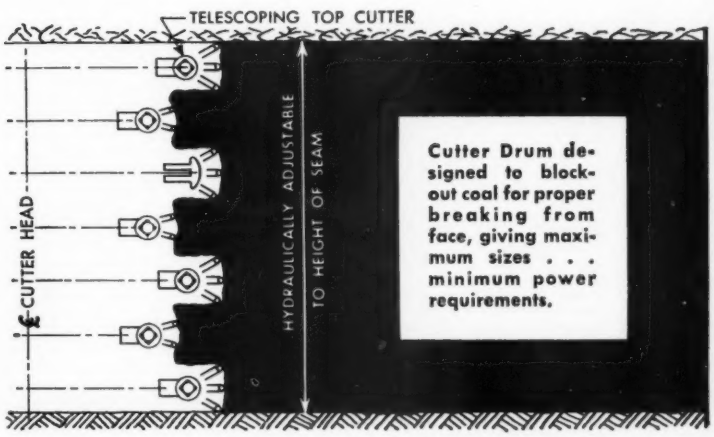
ready for production!

For seams 30" to 48"

Here's how LCM28 *produces profitable tonnage!*

1. Weight 16 tons—rugged and heavy enough to cope with tough cutting conditions.
2. Capacity—2 to 3 tons per minute.
3. Hydraulically driven 24" flexible Conveyor.
4. Two Cutter Heads cut a wide face 16 feet or less.
5. Dual gathering arms have maximum reach of 11 feet . . . will gather ALL the coal regardless of position.
6. Controlled Tramming Speed gives proper sumping action and Dual Pump combination gives high tramming speed.
7. Especially good in cross-cut development!

The LCM28 "Low Coal" Miner employs a new combination of cutting and gathering coal. The vertical mounted extendable cutter drums arc together like a "clam shell."



All Lee-Norse Miners are available in AC or DC power.

Lee-Norse Company

CHARLEROI, PENNA.

Specialists in Coal Mining Equipment

Lee-Norse MINERS keep production on the go!

NEW JOY SHEAVE BLOCKS...

now better two ways

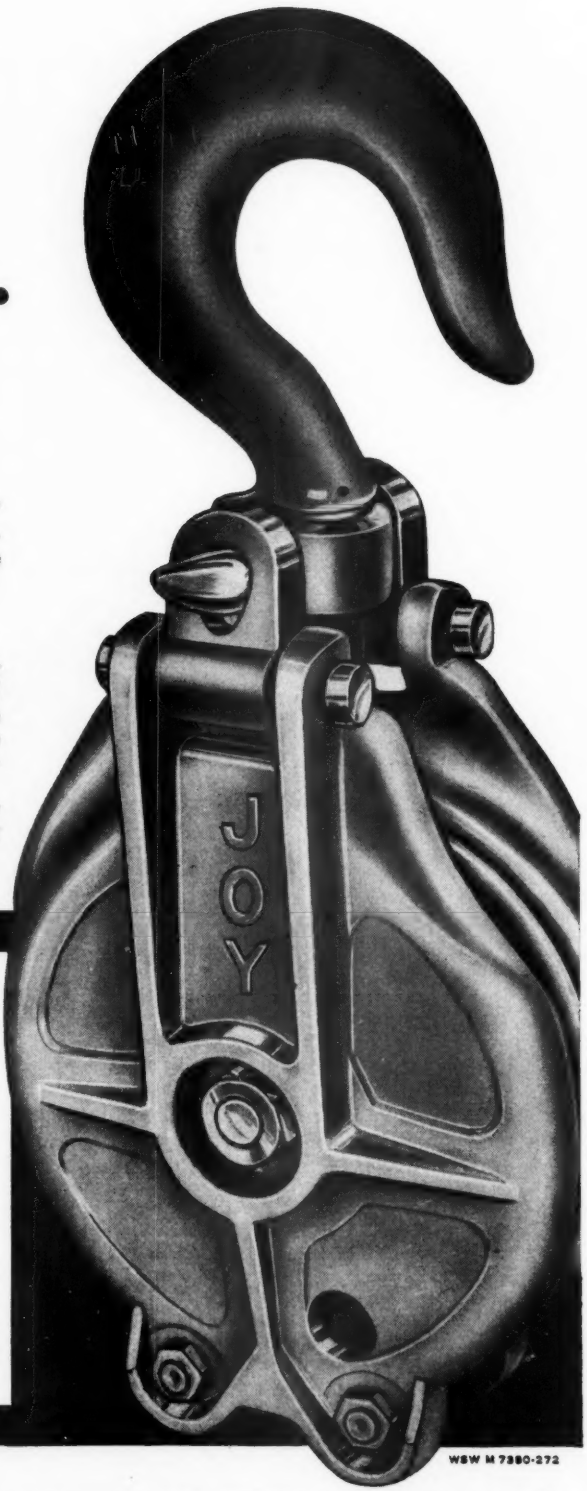
1. FORGED STEEL CONSTRUCTION

The hook and block of the popular 6", 8" and 10" sizes are forged alloy steel. The wheel is made of long-wearing chrome-nickel-moly cast steel. All parts are heat-treated for strength and wear resistance.

2. SIMPLIFIED DESIGN

There are no toggle pins, chains, cotter pins, bolts or nuts to handle or remove. TO OPEN, JUST TURN AND PUSH . . . no parts leave the block to become lost. The rugged opening mechanism will last for the life of the block. What could be simpler for those hard-to-service locations.

Get the full story from ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

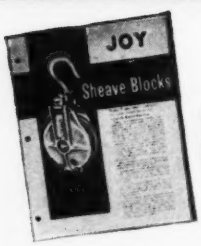


JOY SHEAVE BLOCK SPECIFICATIONS

STYLE NO.	6-F 6-FS	8-F 8-SF	10-F 10-FS	52-D‡	53-D‡
SIZE, INS.	6	8	10	12	14
MAX. ROPE DIA., INS.	½	⅝	⅞	⅞	1
MAX. CAPACITY, LBS.	7,000	8,000	10,000	14,000	20,000
MAX. HOIST AND SLUSHER SIZE, H.P.	15	20	30	45	75
THROAT OPENING W/HOOK, INS., WIDTH	2¼	2⅛	2½	2½	2⅞
HEIGHT	2¾	2¾	3⅝	3	3½
OVERALL DIMENSIONS LENGTH, INS.	18⅛	20⅛	22¾	24	29½
WIDTH, INS.	7	9	11	13½	15½
WEIGHT, LBS.	28	39	47	78	107

Specifications describe quick-opening styles with hook or safety hook, shrouded or open side plates; all styles also available with clevis, split clevis or eye bolt. ‡Furnished with patented Joy pin lock and open side plates only.

WSW M 7380-272



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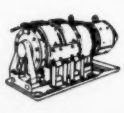
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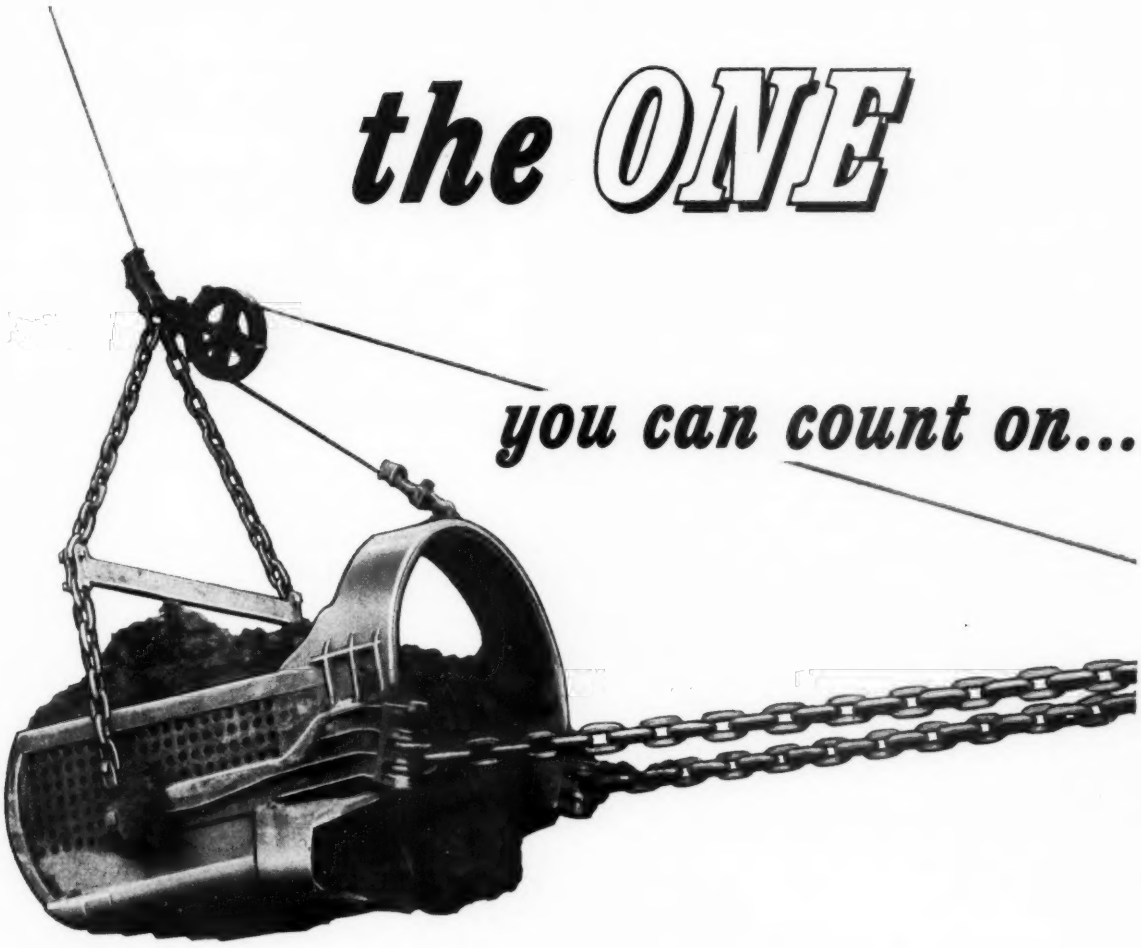

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4½ to 14 Cubic Yards With or Without Perforations

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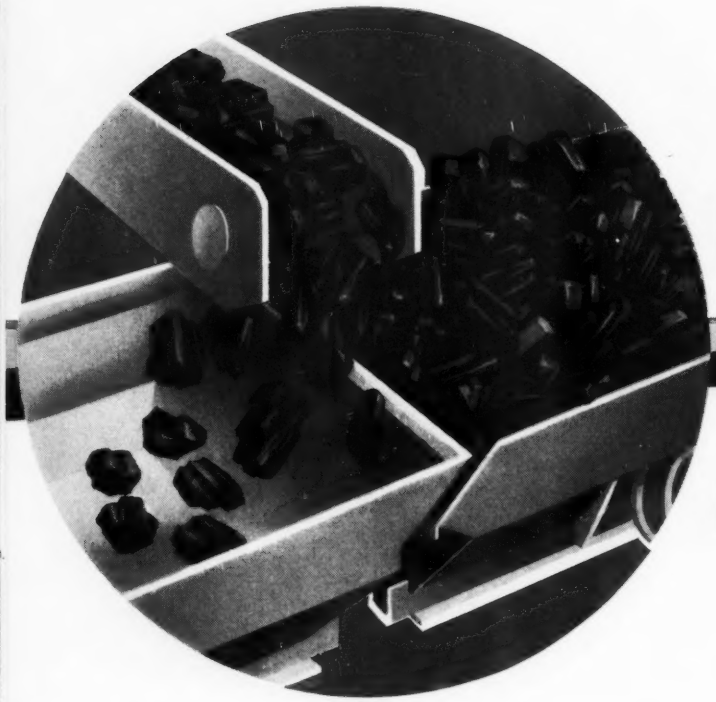
HIGHER ARCH · WIDER FRONT · TAPERED BASKET · GREATER STRENGTH



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Extended Ends on each car catch coal that would otherwise fall between cars: the entire trip is loaded faster, without stopping the trip or the flow of coal pouring from the loading mechanism. Spillage between cars is eliminated. Haulage safety is increased.

Other special features included only in **acf** drop-bottom mine cars:

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Forty years of **acf** experience in mine car design and manufacture back up the **acf** Representative. He can give you full information on all sizes and types of mine car from 2 to 30 tons and larger. Why not discuss your haulage requirements with him? Just call your nearest **acf** Sales Office.

Bulletin describing all types of **acf** *Mine Cars available on request.*

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they go up easy... stay put!

O-B SHELLS AND PLUGS

That simple phrase explains why more mine roof is supported with O-B Shells and Plugs than any other make of expansion unit.

Underground pull tests have proved to hundreds of bolting crews that these O-B expansion units are stronger than their roof bolts. Hundreds more have learned from personal experience that the four-way expansion of these O-B units can't be equalled for holding power in soft top.

And because bolts equipped with O-B Shells and Plugs don't have to be held in the holes before wrenching begins, bolters have both hands free to run their machines—work faster with less chance of injury to hands and fingers.

For extra strength, expansion, speed, and safety, order the Shells and Plugs that "go up easy—stay put!"

Write direct to Ohio Brass, or ask your O-B representative, for an underground test on your property.

OHIO BRASS COMPANY, MANSFIELD, OHIO
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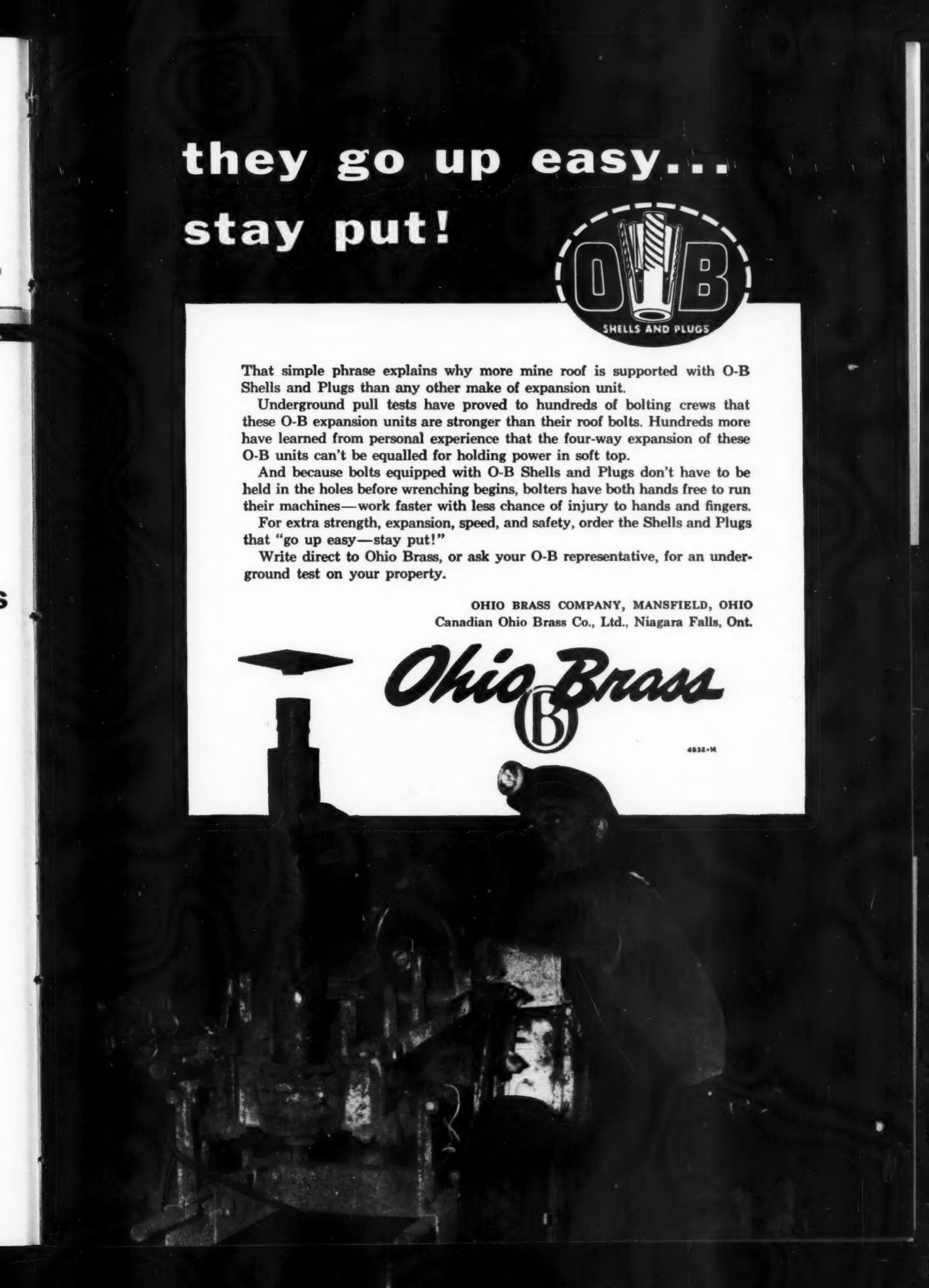


THE SPLICE OF LIFE

When you splice and reinsulate with Uskorona® and re-jacket with "D.R." splicing compound, you renew the life of the cable. *The entire splice will last as long as the cable.*

These entirely reliable tapes are:

- Extra-tight gripping, plus high in tensile strength.
- Resistant to acid, alkalies and moisture ...ideal for use on mining machine cables.
- Impossible to pinhole, so dangerous leaks can't occur.
- Absolutely waterproof.

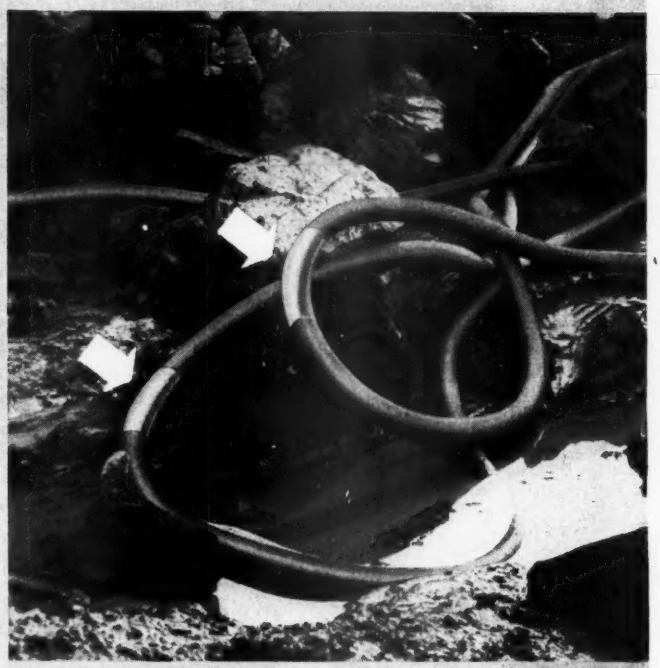
Uskorona exceeds A.S.T.M. specifications and can handle a wide range of electrical and general purpose jobs in mines. A complete line of mine tapes is available.

• • •

When you think of rubber, think of your "U. S." Distributor. He's your best on-the-spot source of technical aid, quick delivery and quality industrial rubber products.

US RUBBER

USKORONA SPLICING TAPE



ABOVE GROUND. When spliced with Uskorona and "D.R." tapes, cables become perfect again. These splices restore the mechanical and dielectric quality of the cable, resist severe abrasion and exposure to moisture.

BELOW GROUND. Being run over by cable cars in coal mine can't hurt Uskorona splices protected by "D.R." splicing compound. They take this punishment many times a day.

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United States Rubber

WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

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NEW S-12

Joins Euclid Rear-Dump Line!

The Model S-12 Euclid-Easton hauler—with payload capacity of 44,000 lbs.—is a new size Euclid over-hung engine type semi-trailer rear-dump. Designed and built as a complete, balanced unit, it combines the experience of two leading manufacturers of hauling equipment for mines, quarries and heavy industrial and construction work.

With 218 h.p. and 5-speed gear transmission the S-12 has a fast travel speed and ample power for the toughest jobs. Big 24.00 x 25 tires on all wheels provide traction and flotation for operation under conditions that would stop other haulers. For work in close quarters the 90° hydraulic steering and variable wheel base gives the unit exceptional maneuverability and helps cut cycle time.

Well reinforced body is constructed of special alloy steel to withstand the impacts of shovel-loaded rock and heavy excavation. Single stage double-acting hoists raise the body quickly, with smooth positive control all during the dumping cycle.

Have your Euclid dealer show you how this Model S-12, or the 12 and 35 ton semi-trailer models with 143 and 325 h.p., can cut hauling costs. He'll be glad to tell you about other Rear-Dump "Eucs" of 10 to 50 ton capacity, too.

EUCLID Division of General Motors Corp., Cleveland 17, Ohio

22-ton capacity
14 yds. struck
218 h.p.
24.00 x 25 tires
22.6 mph top speed

Euclid semi-trailer rear-dumps are available in 3 capacities—12, 22 and 35 tons with 143, 218 and 325 h.p. Tractors for these models are interchangeable on 7, 12 and 21 yd. scrapers.

GM GENERAL MOTORS EUCLID

EUCLID EQUIPMENT

FOR MOVING EARTH, ROCK, COAL AND ORE

EDITORIALS

ROBERT W. VAN EVERA, Editor

JANUARY, 1959

WHAT INDUSTRY WILL BE THE NEXT TARGET OF RUSSIA'S ECONOMIC WARFARE?

That the cold war has remained cold is a blessing to all humanity, but the fact remains that the free world still has to combat Russia's cold war aggressions. Walter L. Rice, president of Reynolds Mining Corporation, presented very clearly his analysis of Khrushchev's determination to destroy the capitalistic nations by economic warfare in his talk on "Light Metals" at the recent AMC Convention in San Francisco.*

By manipulating prices in carefully selected markets, the Russians can play havoc with basic competitive industries in the Western world—and at the same time can generate a movement of foreign currency to the Soviet Union. Prices sporadically set by a dictator need bear no relationship to costs of production, but their damaging influence on vital free-world industries is of serious concern to all free people.

Because the mining industry deals in the nation's most basic industrial commodities, it is particularly vulnerable to Russian economic attacks. While the aluminum industry has already been affected, the Reds have the resources and the potential industrial might to make similar attacks on other branches of mining—particularly in view of the high cost of American labor.

Rice supported his arguments with specific illustrations to show that Khrushchev and Co. are purposely setting out to disrupt vital Western industries.

Russia has undertaken, and has advanced spectacularly, ambitious programs of expansion in aluminum, steel, and many other commodities—and we must anticipate frequent instances of surpluses behind the Iron Curtain. In the case of aluminum, Russia has periodically dumped metal onto the British and European markets at prices seven to eight percent under the market. This action, Rice said, has reflected itself in exports of fabricated aluminum to the American market at prices 20 percent below market.

"Late in 1957 when the Western aluminum market was receding, Russia offered aluminum to England, Germany and Belgium at a two-cent discount below Western prices. Soviet domestic prices were maintained at a rate 139 percent higher.

"When the United States called for competitive bids on 250,000 pounds of aluminum plate, the lowest bidder—20 percent below the average of all domestic bids—represented a Belgian mill purchasing Russian aluminum. The order was awarded to the Russian metal."

During the 1955 scarcity of aluminum, Russia was exacting a 28 percent premium above world prices for the aluminum it sold. As Rice points out, "The United States cannot depend upon foreign producers in times of emergency. When we have an oversupply they open the flood gates; when they are in short supply, imports decline." In the interest of national defense our raw materials industries must remain strong. Means must be devised to protect them from disruptive, hit-and-run economic attacks that are conceived in the Kremlin.

HOW MUCH PROFIT?

GEORGE GALLUP, Director of the American Institute of Public Opinion, recently announced the results of a special world Gallup poll concerning misconceptions by the American public, and by people abroad, regarding the nature of United States capitalism.

In answer to the question, "Just as a rough guess, what percent of profit would you say the typical industrial firm makes?" the following answers were received in cities throughout the world.

	U. S. Firm	*Firm in Own Nation*
Montevideo	60%	65%
Vienna	50	50
New Delhi	47	
West Berlin	47	35
Paris	40	30
Amsterdam	40	27
Brussels	39	39
Oslo	39	26
Copenhagen	33	21
Stockholm	31	22
Helsinki	30	20
Athens	30	30
Melbourne	27	33
Rome-Milan	25	15
New York-Chicago-San Francisco	20	

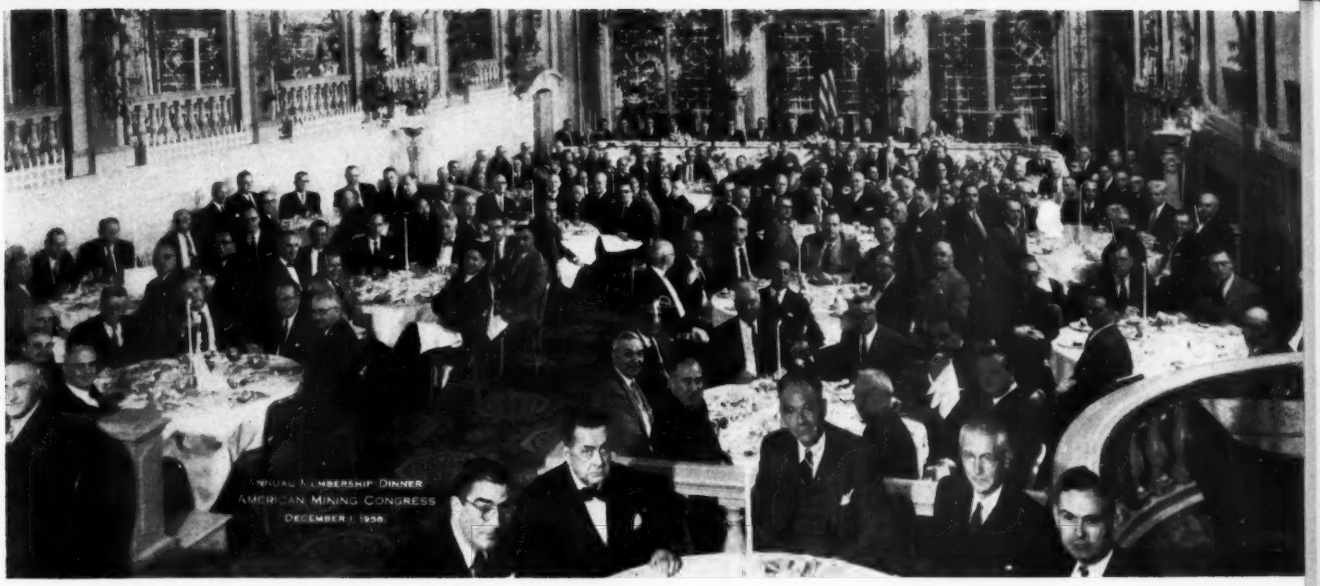
It would seem that the public has only scant knowledge of the cost of staying in business.

Indeed, if the public's notions about corporate profits, as shown by this survey, were only true, we in the American mining industry would be sitting pretty—and more so if this profit picture were "after taxes"! Our government could pay off the national debt—instead of constantly slipping deeper in the hole. Mines would operate at top employment and workers' earnings would be higher. Our mineral resources could be conserved, as it would be unnecessary to "gut" the high grade resources to stay in business. Mining communities would thrive, and increased dividends would funnel back into the capital structure to strengthen our economy.

But we're afraid that it just isn't in the books to accomplish this now under a competitive industrial system—and certainly it would be even less likely in a controlled economy.

As Dr. Gallup concluded, it appears that "the United States has a job to do in informing not only the American public, but also people abroad, on the nature of U. S. capitalism."

* Mr. Rice will discuss this subject further in his review of "Light Metals" in our Annual Review Issue next month.



A M C ANNUAL MEETING

Raymond Salvati New President of American Mining Congress

Howard Young Honored for Quarter Century of Service to the Industry

THE regular annual meeting of members of the American Mining Congress was held at the Plaza Hotel, New York City, Monday, December 1st. President Howard I. Young called the meeting to order and introduced other AMC officials who presented their customary reports.

In the absence of Andrew Fletcher, chairman of the finance committee, Raymond E. Salvati reported on the financial position of the American Mining Congress, summarizing the 1958 income and expenses and showing a balanced budget for the year. He stated that "although the workload is increasing and expenses next year will be somewhat higher, we expect the overall income to be adequate to cover operating costs . . . ."

Julian Conover, executive vice president, gave a short report on the work of the Mining Congress over the past year, and outlined some of the matters that will call for the industry's attention in 1959. He called attention to the general situation in Washington and the change in the climate there as a result of the recent elections. "Industry", he said, "will face a less congenial, and labor a more responsive atmosphere. Proposals for

LEO A. HOEGH, DIRECTOR OF THE OFFICE OF CIVIL AND DEFENSE MOBILIZATION, SPOKE TO THE MINERS

The American Mining Congress

presents this

Award of Exceptional Merit and Tribute of Appreciation

to

Howard J. Young

In recognition of his untiring efforts and devoted service as President of the American Mining Congress over the past twenty-five years, during which time this Organization has grown in stature and in public recognition, and has made significant contributions to the advancement of the mining industry of the United States.

Possessing innate qualities of leadership, breadth of vision, deep sincerity of purpose, warm human sympathy, driving energy, unfaltering courage and steadfast adherence to the tenets and principles of our free society, together with a devout belief in the teachings of Christ, he commands the respect, admiration and affection of the entire mining industry.

Howard Young's natural abilities and his infinite capacity for hard work carried him rapidly from a humble beginning to the presidency of the American Zinc, Lead & Smelting Company. He has recently completed a half century of service with this company, which under his guidance has risen to great heights in the mineral industry.

During the Nation's grave emergency in World War II and again during the Korean conflict, he willingly placed his talents at the disposal of the Government, at great personal sacrifice, and served in high posts with singular distinction. His efforts enabled the Government to bring about rapid expansion of mineral production and to obtain the basic raw materials which are the sinews of our military strength.

Recognition has come to Howard Young not only in his chosen field, but also from his church, his community, and his State, to which he has given unstintingly of his time and effort. Outstanding American corporations and business organizations have called on him to serve on their boards of directors, and he has received honorary degrees from several institutions of higher learning.

As President of the American Mining Congress, he has ceaselessly championed the cause of the domestic mining industry, which is so vital to our national welfare, and has rendered a unique service in welding the various branches of this great industry into a united organization working for the common good.

In retiring as President of this organization, Howard Young takes with him the gratitude and sincere good wishes of this Board and of the membership throughout the country. His record of achievement will be a continuing inspiration to those who in the future take up the duties which he has performed with such conspicuous success.

Subscribed by the Board of Directors of the American Mining Congress
New York, N. Y., December 1, 1958

increased spending and expansion of Federal activities will receive wide support, and it remains to be seen to what extent the inherent conservatism of some of the leaders, together with the President's veto powers, can slow this trend." He stressed the great importance to all of us of explaining the mining industry's problems in official Washington whenever necessary.

Conover reviewed the tax situation, pointing out that some real progress was made last year—including the new statutory definition of the "property" which forms the basis for computing depletion, the repeal of the excise tax on the transportation of property, and the extension of the net operating loss carry back to three years. However, he warned of the need for continued vigilance in such matters as percentage depletion, which is receiving increasingly critical attention in Washington.

He discussed national mineral policies, the trade agreements program, labor legislation, public lands and legislation affecting the coal industry in some detail, and called attention to many other problems which have received attention in the past year, or will require action in the months to come. On behalf of the AMC staff members, Conover expressed their great appreciation for the opportunity to work for and with the members of the mining industry.

Leo A. Hoegh Guest Speaker

The main address of the evening was given by Leo A. Hoegh, director of the Office of Civil and Defense Mobilization. Hoegh outlined the mission of his highly important agency which is charged with the spearheading of all nonmilitary aspects of the national defense, including the mobilization of resources and production.

LOUIS CATES PRESENTED TESTIMONIAL SCROLL TO HOWARD YOUNG

He reiterated previous announcements that only four items are being purchased for the national stockpile during the current fiscal year, but that the stockpile is continuing to receive deliveries of metals and minerals as a result of contracts executed in past years under authority of the Defense Production Act.

Hoegh announced that OCDM is undertaking a $7 million program of upgrading copper, molybdenum, vanadium, and tungsten to a state of ready usability. He added that the stockpile contains materials which are not of suitable grade or form for long-term retention, and that if disposal becomes desirable, "this will be done without upsetting commercial markets or adversely affecting the international interests of the Nation." Another OCDM project, Hoegh said, involves close study of materials with high-temperature or other special properties for defense use, and special programs for them may result "if defense requirements become reasonably firm."

The OCDM director also noted that Congress has made him responsible for administering the National Security Clause of the Trade Agreements Act. Under this clause, he must report to the President whenever he has reason to believe that imports of any article threaten to impair the national security. Hoegh said his agency has pending three petitions, involving tungsten, cobalt, and fluorspar, which have been filed under provisions of this clause. Before he reaches any conclusions, Hoegh declared, he will seek advice from other Government agencies and information from industry.

He cautioned producers that they should avoid making foreign trade a "whipping boy" when imports are of minor consequence, declaring that "the interest that the law requires me to safeguard is the security of the Nation. Naturally, basic to that security is a strong domestic economy . . ."

Ten Directors Elected

Nominations for directors of the American Mining Congress were submitted by Paul B. Jessup, chairman of the nominating committee. They included: for a three-year term, Merl C. Kelce, president, Peabody Coal Co.; F. S. Mulock, president, U. S. Smelting Refining & Mining Co.; Charles J. Potter, president, Rochester & Pittsburgh Coal Co.; H. A. Sawyer, president, Lone Star Cement Corp.; Albert E. Seep, president, Mine & Smelter Supply Co.; Merrill E. Shoup, president, Golden Cycle Corp.; Harrie S. Taylor, president, Oglebay Norton Co.; Clyde E. Weed, chairman of the board, The Anaconda Co., and Howard I. Young, president, American Zinc, Lead & Smelting Co.; and for a one-year term Ellery Sedgwick, Jr., president, Medusa Portland Cement Co. All nominees were elected by unanimous ballot. A vote of appreciation was extended to the retiring members of the board, D. S. MacBride, Walter A. Wecker and J. E. M. Wilson, for their service and devotion to the American Mining Congress.

Tribute Paid to Howard Young

A highlight of the meeting was the presentation to Howard I. Young by Louis S. Cates, a former AMC president and member of the American Mining Congress since 1914, of a testimonial scroll signed by all members of the board of directors. Cates paid a special tribute to Mr. Young, who is retiring as President of the American Mining Congress after 25 years of distinguished service in that office.

Mr. Young accepted the tribute with an expression of his deep appreciation. He spoke briefly of the fine cooperation and support that have been extended over the years by all branches of the mining industry and by the manufacturers of mining equipment —which has made possible the growth of the American Mining Congress and enabled it to render a high measure of service to the industry. He emphasized that his interest in the organization would remain undiminished, despite his retirement from the presidency, and that he would be glad to aid in every way possible in its future work. A prolonged standing ovation was given to Mr. Young, testifying to the deep respect and affection in which he is held by the entire industry.

FINANCIAL REPORT, SHOWING A BALANCED BUDGET, WAS PRESENTED BY RAYMOND SALVATI

Board of Directors Meets

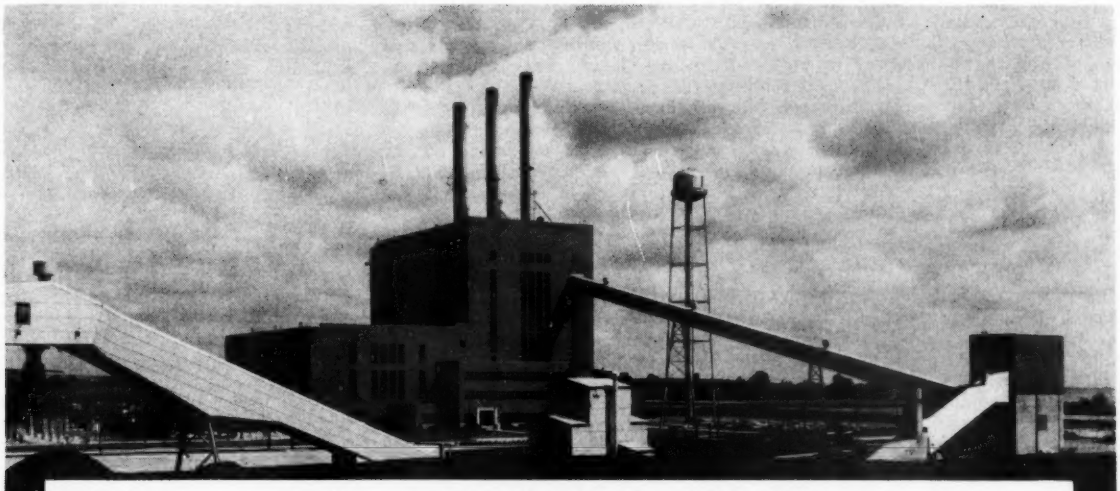
At a meeting of the Board of Directors immediately following the membership meeting, officers for the coming year were elected. Raymond E. Salvati, president, Island Creek Coal Co., was elected president, and Andrew Fletcher, president, St. Joseph Lead Co., Herbert C. Jackson, associate managing partner, Pickands Mather & Co., and Clyde E. Weed, chairman of the board, The Anaconda Co. were elected vice presidents.

The incoming president, Raymond E. Salvati, a graduate of West Virginia University, started his career with Island Creek Coal Co., now the nation's third largest producer and distributor of bituminous coal, as an underground trackman in 1922. He progressed steadily through positions of increasing responsibility and became president of the company in 1947. Distinguished achievements in advancing the science of coal mining, inspiring industrial leadership, and efficient service to civic, professional and charitable causes have won Mr. Salvati wide recognition and a number of outstanding awards over the years—the most recent of which was the Horatio Alger Award for 1958. He is a director of the National Association of Manufacturers, the National Coal Association, the West Virginia Coal Association, and has served in a similar position with the Bituminous Coal Research organization. An AMC director since 1949, and vice president since 1953, Mr. Salvati is eminently qualified through his long experience in mining to serve as President of the industry's national organization.

Special Committees Meet

A joint meeting of the Land and Water Use Committees of the American Mining Congress and the National Coal Association was held following a luncheon on December 1st. L. E. Sawyer of the Indiana Coal Association, chairman of the AMC Land and Water Use Technical Committee, presided. Developments concerning public land management, reclamation and reforestation of mined-over lands, and water and air pollution abatement were discussed by committee members representing the various states and mining districts throughout the country.

The Tax Conference on Tuesday, directed by AMC Tax Committee chairman Lincoln Arnold, was attended by over 120 tax men from the mining industry. A variety of topics was discussed, with attention centering on the new statutory definition of the "property", which forms the basis for computing depletion, and on the problems involved in determination of the cut-off point for depletion purposes.



COAL and the ELECTRIC POWER Industry

By EUGENE GORDON
Vice President-Power
West Penn Power Co.

It is estimated that by 1975 the annual coal requirement of the electric utilities will be between 400 and 500 million tons —roughly equivalent to today's total coal consumption! Future plans of power companies are based on the belief that coal suppliers will keep alert to the use of improved machinery and mining methods to produce coal at the lowest possible cost

DURING World War I a station which consumed 1000 tpd of coal was thought to be a large central station, whereas today it is not uncommon for a single steam generator to consume 1½ times that amount of coal in a like period. In a similar vein, a 20,000 hp main turbo-generator was really a large machine at that time; today, a unit of this size is planned for driving the boiler feedwater pump required for a single large main unit. This is just an example of the rapid growth of the electric utility industry and the vast increase in the capacity of the equipment used to supply the demand for electric energy.

So much for reminiscing. My message really concerns the common aim of the coal and electric power industries. I realize, of course, that the coal industry supplies large quantities of coal to customers other than the electric utility industry, but to the extent that the electric utility industry is already the coal industry's largest customer and will undoubtedly become an even larger one, our common goal is to supply the consumer with a cheap and reliable supply of energy in a convenient form. In fact, the stated objective of my company is: "To supply customers adequate and reliable electric service at the lowest rate consistent with fair treatment of employes, reasonable earnings, and our obligations as citizens in the communities we serve." Analytically, then, it is the coal industry's function to remove energy, in the raw material form, from the earth, and it is our function to convert that energy to a convenient form and to distribute it to the consuming public.

Obviously the two industries' respective functions are interrelated, and how far they go towards achieving their common goal will, in a large sense, be measured by how well each performs his function. Coal is cognizant of its competition—that is, competition from other fuels such as gas and oil; also atomic energy, water power, etc. We, in the electric utility industry, are often accused of having no competition, but the facts do not bear out the accusation. We compete with gas and oil, used for heating and cooking purposes; we compete with subsidized public power in order to attract customers, and we also compete against the customer's prerogative of generating his own electricity. In spite of any competitive influence, however, there is little doubt that the electric utility industry will continue to grow and that in doing so it will have to look to the coal industry for

constantly increasing amounts of fuel.

Statistically, the situation looks about like this: the total consumption of coal in this country in 1957 was approximately 414,000,000 tons, of which electric power utilities consumed 157,000,000 tons, or approximately 38 percent of the total. It is estimated that by 1975, the annual coal requirement of the electric utilities will be between 400 and 500 million tons, or as you can see, they will be roughly equivalent to today's total coal consumption. You may also be interested in knowing that in 1957, 79 percent of the electric industry's kilowatthour output came from steam plants, 20 percent from hydro-electric plants, and less than one percent from internal combustion engines. It is curious to note that TVA, which started and is generally thought of as a hydro development, produced 72.8 percent of its output in 1957 from coal. On a national scale, the percentage of electric power supplied by hydro-electric plants has been declining for more than ten years, and there seems to be little doubt that this trend will continue.

West Penn Power's subsidiary companies operate two coal mines, each of which has a productive capacity of approximately 1,000,000 tons per year. One of these mines feeds a power plant operated on a joint basis between West Penn and one of its neighboring companies, while the other supplies fuel directly to our Springdale Power Station. The significant thing, at least to West Penn, is that whereas in 1947 we mined approximately 90 percent of our coal requirements, by 1957, due to our increased needs, only about 60 percent of our total consumption came from our own mines. Our budget figures indicate that only about 38 percent of our needs will be provided by our own mines in 1959.

Plant and Fuel Costs—Major Items Affecting Generating Cost

This fuel has been described as a combustible solid resulting from the accumulation and burial of vegetation in previous geologic ages. Coal is composed chiefly of carbon, hydrogen, and oxygen with small amounts of nitrogen and sulphur, and varying amounts of moisture and mineral impurities. Coal is available in a wide range of chemical and physical properties. About 58 percent of the Nation's coal output goes through some form of cleaning plant where clay, slate, and other impurities are removed. Since between 75 and 80 percent of the bituminous coal produced is transported to the point of consumption by railroad, it is desirable to not only clean the coal before shipment, but also at times to remove excessive moisture and thereby minimize the hauling charges, thus enabling the user to secure fuel at the lowest cost.

Since the cost of plant and the cost of fuel are the two major items affecting the cost of electrical generation, it behooves the plant design engineer to balance these components in his calculations so as to arrive at the lowest over-all production cost. It, therefore, becomes necessary to determine as completely as possible, the characteristics and exact qualities of the fuel to be used, and how much it will cost, before the fuel burning and electric generating equipment is selected. Where fuel cost is high, as is often the case when transportation charges are a major factor, it is desirable to design and build for high performance. Where this situation exists, large units would probably be installed using steam at the highest practical pressure and temperature; likewise, the thermal cycle to be economical, should make use of the maximum amount of heat recovery equipment. Conversely, when fuel cost is low, plant equipment must be carefully scrutinized to make certain that a satisfactory return is realizable on the capital invested. There are occasions when it is advantageous to utilize a low grade source of fuel; building the power generating station close to the source in order to reduce transportation and constructing the fuel burning equipment to utilize the coal as mined without any preparation outside the power plant.

Coal would be sized and dried by the equipment in the plant and then burned in very large furnaces to minimize slagging and tube fouling. Very efficient dust recovery equipment is required to clean the stack gases to acceptable standards and the gas velocities must be kept low throughout the entire steam generator to prevent tube abrasion. We have installed units of this kind and have experienced favorable results from the concept.

Modern Stations Using 0.75 Lb of Coal Per Kwh

Generation of electricity is, in reality, a process of converting energy from one form to another. It is, therefore, essential that we secure low cost raw material. The average amount of coal consumed per kilowatthour of electricity generated last year was 0.93 lb, which represents a decline of 38 percent in the past 25 years from an average at that time of 1.49 lb per kwh. Our more modern stations are using 0.75 lb of coal per kwh, and future developments and improvements in generating equipment should enable us to continue to reduce this figure.

As previously stated, we at West Penn are anticipating that 62 percent of our fuel requirements for 1959 will be purchased from sources not connected with our company, and we are contemplating that the suppliers of this fuel will keep alert to the use of more powerful machinery and modern mining methods to produce coal at low cost. You may be interested to know that this coal is purchased and paid for on the basis of the relative heating value per pound. It is necessary, however, in order to arrive at the proper and satisfactory value per ton or per million Btu as received, that factors other than straight cents per million Btu be evaluated. Our final criterion of value of any coal is based on the cost per kwh of electric energy produced from that coal in the particular plant or generating unit involved. This means that we must consider such factors as coal and ash handling costs, burning characteristics of the coal and its effect on operating and maintenance costs, and a host of other considerations.

As you all doubtless are aware, the electric utilities have, by taking advantage of the improvements in generating efficiency and with the constant installation of modern equipment, been able even in the face of rising costs for labor and materials, to hold the line on production cost. The coal producing industry has likewise, by the use of modern mining machines and improvements in coal mining technology, realized a relatively stable average production cost. This, again, has been accomplished notwithstanding the national inflation with rising wages and increasing cost of materials. The mutual interests of both of our industries will best be served if we can continue our efforts toward this end.

Nuclear Energy Will Supplement, Not Replace Coal

The impact of nuclear energy is going to have a profound effect on the electric power industry. More than 100 electric utilities in the United States are currently engaged in 22 separate nuclear power projects which will result in the construction of 19 nuclear power reactors. Total capacity of these projects is 1.5 million kw and the estimated cost to the utility companies about $500 million.

The interest of power engineers lies, not only in doing better what we already know how to do, but also in proving the technical and economic feasibility of new ways and means of meeting future requirements. Clearly, nuclear energy is not at present an economic alternative to conventional generation methods in this country; that is, methods which employ fossil type fuels. This fact is particularly true for those utility companies, such as the one with which I am associated, located near a plentiful supply of the conventional fuels.

A recent study undertaken by the

Edison Electric Institute, a trade organization of electric utilities, indicates that, "The day of generally competitive nuclear power in this country may be as much as 10 to 20 years away." "This time spread, of course, will be shorter in some areas of the country than in others, because the cost of fossil fuels has rather wide variation geographically."

It is significant to note, however, that even in Great Britain, a country where nuclear energy has obtained its strongest foothold with respect to the generation of electricity, there has been considerable comment that all of the new power stations cannot economically be nuclear. The reason for this stems from the fact that the first cost of nuclear stations is considerably higher than that for its conventional counterpart, and this is a situation not likely to change in the foreseeable future. Given that the first cost of nuclear stations is higher, they must then be operated at essentially base load to be at all economical. It is quite apparent that all stations cannot be operated at base load if an electric utility is to match its customer load, both on-peak and off-peak. The consequence is that, in spite of the high cost of fossil fuels in Great Britain, some of their new power plants will undoubtedly be designed to burn fossil fuels.

The point of all this is that, even under the best or worst circumstances (depending on your viewpoint), nuclear energy will serve to supplement and not replace our conventional generation methods.

I might take time to tell you of West Penn Power's activities in the nuclear field. Recently, the company joined with some 13 of its neighboring utility companies to form a nonprofit research corporation, known as the East Central Nuclear Group. ECNG, as it is known in this day of abbreviations, in cooperation with two Florida utility companies, has proposed to the Atomic Energy Commission a program to build a 50,000-kw high-temperature, gas-cooled, heavy water-moderated, pressure tube reactor. The fuel used will be slightly enriched uranium, and the reactor will be the first of its kind. Although this reactor plant is not expected to produce economically competitive power, if successful, it is expected to serve as a prototype for a larger 200,000-kw plant whose economics, it is hoped, will be much more favorable.

The program, as proposed, has several attractive features: first of all, the prototype reactor will be built in Florida where the premium to be paid for nuclear energy is not so great, due to the higher cost of conventional fuels in that area of the country; secondly, the member companies of ECNG, all of whom enjoy relatively low fuel costs, but who have a sincere desire to contribute to nuclear research and to acquire nuclear "know-how" will have an opportunity to do so without incurring the penalty of higher cost energy. It is estimated that the prototype reactor will be operational around June 30, 1963.

Economical Fusion Power Not Likely For Many Years

Before we leave the subject of nuclear energy, I might say a word about fusion or thermonuclear power. There is no doubt that if an economical process can be developed for harnessing the world's reserves of heavy water, our energy problems will be solved for as far into the future as we might care to look. Nonetheless, an honest appraisal of the work done so far in this field seems to indicate that the publicity has far outrun the technology. There is no intent here to discredit those who have worked and continue to work so diligently on the formidable problems in this area, but some of the most authoritative accounts estimate that, at best, economical fusion power on a substantial scale will not be likely to make its appearance before the final two decades of this century. There is certainly no guarantee that we will ever be able to harness the fusion process, and already there are indications that if we do succeed in harnessing it, the economics may not be overwhelmingly attractive.

In some measure, it seems that the coal industry has been unduly concerned with regard to the competitive potential of atomic energy. Although we, in the electric utility industry, share the coal industry's distaste for unfair and overly-subsidized competition, a fair appraisal of the situation indicates that atomic energy will supplement and will not replace coal as a source of electrical energy. There is no doubt that the atomic business has, to date, been a better customer than a competitor of the coal business. The amount of coal consumed to supply electrical energy to the AEC's gaseous diffusion plants is enormous by anybody's standards. Along another line, long range research is currently being performed by the Bureau of Mines and others towards applying high-temperature nuclear heat to the hydrogenation of coal, and if this research is successful, broad new markets for coal will be opened up.

West Penn Is Supporting Coal Research

In telling you a moment ago of West Penn's activities with regard to nuclear research, I may have created the impression that we are applying all our limited research funds to the nuclear field. This is not the case, for we are proud to be one of three electric utility companies on the membership roster of Bituminous Coal Research, Inc. In addition, through our membership in the Edison Electric Institute, we are contributing to a research project, which is being financed jointly by the electric industry and the coal industry, the purpose of which is to investigate methods for reducing sulphur in steam coals, and to perform exploratory research on methods for control of atmospheric contaminants in flue gases. We have also cooperated with the Bureau of Mines in their investigations of trace elements, such as germanium, in coal and in fly ash. As you undoubtedly know, both our industries have been interested in finding constructive uses for fly ash, thereby converting this material from a waste product to a useful by-product. Although we have but scratched the surface in this area, continued effort will unquestionably lead to meaningful results.

By way of summation, we in the electric utility industry, have a deep and abiding interest in the general good health of the coal industry. In particular, at West Penn Power, where we are privileged to supply electrical energy to a large number of coal mines, our concern is more than that of a disinterested observer. I am quite frank with you in stating that our concern over the long haul, is not that the coal industry will fail to grow, but rather that it will grow so fast that we will be hard pressed to acquire sufficient coal to satisfy our ever-expanding requirements. We take consolation, however, in knowing that you gentlemen will be able to meet the challenge.

How far the coal and electric industries go towards achieving their common goal of economical operation will be measured by how efficiently each does its job

HYDRAULIC FILLING

By RICHARD M. STEWART

Assistant to Director of Mining Research
The Anaconda Co.

Because of its inherent advantages, the use of hydraulic fill has captured the imagination of engineers and operators throughout the world. Their attention is focused on improving backfilling systems and extending the range of practical applications

The Montana School of Mines, with the cooperation of The Anaconda Co., United States Bureau of Mines, Mining Association of Montana, Montana Section of AIME, Montana Society of Engineers and Alumni of the Montana School of Mines, recently held an outstanding Symposium on Hydraulic Stope Fill. Eleven papers were presented by authorities in the various fields associated with hydraulic filling. The objective of the symposium was to present detailed technical information and data on the subject. This article brings you a few highlights from that symposium.

The author would like to suggest that readers, who are interested in studying the wealth of detailed information collected at the symposium, secure a copy of the proceedings which are available from Montana School of Mines.

THE ideal fill for mines is the material which can be placed underground at the lowest cost and which supports the greatest load with least compression.

U. S. Bureau of of Mines' tests comparing load-bearing characteristics of hydraulically placed sand with various dry-placed, sandrock mixtures indicated much higher compressive strength for the hydraulically placed sand. It required up to 12 times as much pressure to compress hydraulic fill five percent in volume. Hydraulic placing gives denser initial packing and correspondingly higher load-bearing qualities.

Mill tailing is the usual source of hydraulic fill. A simple dewatering and desliming operation makes this waste material suitable for back-filling. This classification process is designed to remove most of the water and yield a slurry of from 55 to 75 percent solids by weight. The pulp density varies with the pipeline flow characteristics and the specific gravity of the solids being transported.

Wet Cyclones Used to Prepare Mine Backfill

Wet cyclones have been widely used to classify mill tailing. Excess water and slime are removed in the overflow, while the thickened spigot pulp contains sufficient water to fill the voids between sand particles, plus a slight excess to provide fluidity. When the pulp is placed underground, this water must be rapidly drained from the fill to permit miners to work on it and to allow blasting. If not adequately drained, the fill remains fluid and exerts severe hydrostatic pressure on the bulkheads containing it.

Slime must be removed from the fill material so that water will drain through the interstitial spaces between particles. The minimum percolation rate is generally four in. per hr. It is achieved by removing most of the minus 10 micron slimes: approximately one percent minus 10 micron can be tolerated. It is usually possible to recover about 50 percent of a concentrator tailing as suitable granular backfill sand. Most mines using backfill require from 30 to 50 percent of the mill tailing to fill stopes. The simple classification process provides a superior mine fill material from the standpoint of load-bearing characteristics, economics, efficiency and adequacy of supply.

Transportation of Slurries Studied

Associated with milling, pulp preparation, and emplacement, is a material handling design problem; that of furnishing an adequate, economical transportation system for hydraulic fill material. Basic design requirements of a pipeline for slurry transport generally are established by the volume of fill material required underground in the stoping area.

Although there is relatively little information available on pumping and flow of slurries in pipelines, pioneering research work in this field has been applied recently to several outstanding projects:

1. **The 108-mi Pittsburgh Consolidated Coal line**
2. **The 72-mi American Gilsonite Co. line**
3. **The 20-mi line of Marmoles y Cementos in Columbia, in which limestone is transported**
4. **The concentrate and tailing lines of International Nickel Co. at Copper Cliff, Ont**
5. **The South African lines that carry repulped gold tailing for subsequent recovery of uranium**
6. **Dredging projects in Florida and at Attikokan in Ontario**
7. **The proposed 17-mi Andes Copper Co. concentrate pipeline in Chile, where the specific gravity of the particles is five**
8. **Many mine back fill plants in the Western U. S. and Canada**

A slurry must be pumped through a pipeline at a practical velocity, which lies between the higher velocities with their severe power and abrasion problems, and the lower velocities

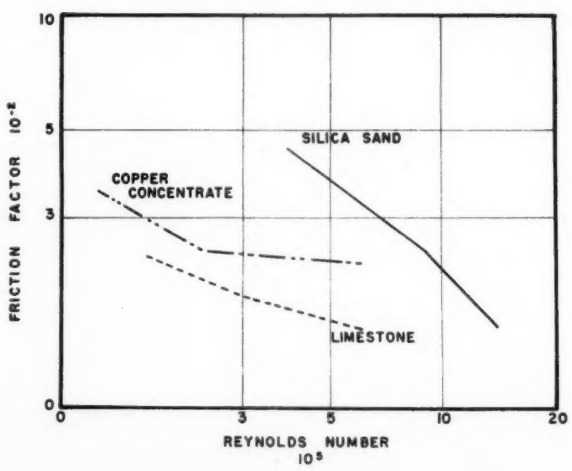


Fig. 1. Friction factor versus Reynolds number for 30 percent slurries

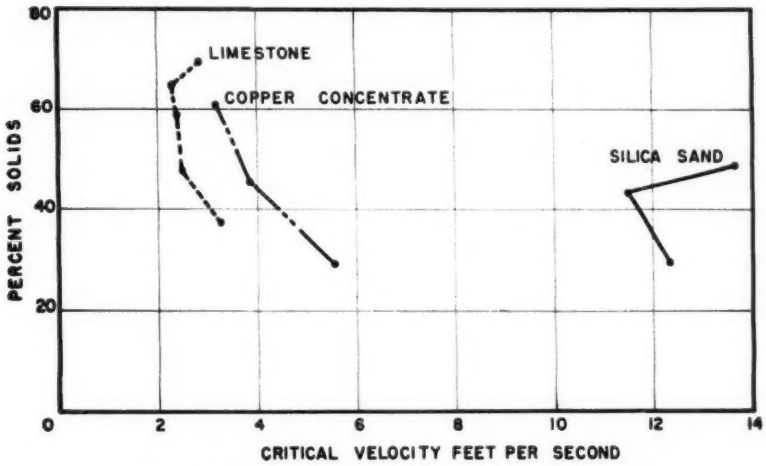


Fig. 2. Critical velocity of slurry at various concentrations

with their danger of plugged pipelines. The minimum velocity at which a slurry will flow through a pipe with all of the solids carried in suspension is the critical velocity.

The many variables that may influence the flow of solid-liquid suspensions in a pipeline make the design of hydraulic fill transport systems difficult. For instance, variables affecting pressure loss due to friction along a pipeline may include: (a) flow rate in terms of velocity, (b) mixture density, (c) specific gravity of the solid-liquid components, (d) particle size distribution of the solids, (e) pipeline diameter, and (f) viscosity of the slurry and its changes with time.

It is not possible to calculate the behavior of a solid-liquid suspension system because of the many variables and the absence of technical data and knowledge in the higher density range. It is possible to make a calculated guess as to the pipe diameter and pumping requirements for a system, and to conduct experiment design work at approximately full scale. (See figures 1 and 2.) One approach is in deriving differential equations of flow by Hamilton's principle for nonconservative systems. This is a mathematical method that has worked for other such problems. If equations are derived, they can be programmed for analog computer and a system can be simulated. A pipeline should then be constructed and operated to see what happens.

Radioactive materials are often used to determine pipeline wear. Further, radioactive isotopes and x-ray techniques are capable of giving information about flow within the pipe. Actual pilot plant tests are required in order to finally select the pipe size, the pumps, the operating velocities and other components. These results may be extrapolated safely within a narrow range. However, it is dangerous to extrapolate based on classical hydraulics theory for ideal fluids since the rheological properties of thick slurries are not ideal and actually approach plastic flow. Most lines of interest to the mining industry are operated with turbulent flow.

Calera Operates Highest Head Sand Pumping System

The Hydraulics Institute, which is made up of major pump manufacturers in the United States, sent out questionnaires to pump users relating to design of pipelines carrying slurries. This survey has shown that there is a great divergence of opinion, even among engineers, concerning a number of very important points. As one example, the questionnaire set forth a specific problem involving handling of a certain material at a certain concentration within a certain sized pipe. The questionnaire asked what coefficient of friction, based on the well known William & Hazen's formula they would apply to this particular problem. Twenty-three recipients answered the question with something like 23 different answers. A new questionnaire is being prepared with the hope of pinpointing specific subjects on which basic research should be conducted.

The highest head sand pumping installation in the world today is at Calera Mining Co. near Cobalt, Idaho. There, hydraulic fill is pumped from the mill at 45 per cent solids through a six-in. wood stave line. The pipeline is 7167 ft long and rises 977 ft. The total dynamic head is 1066 ft. Sixteen centrifugal materials handling pumps in series are installed along the line in eight pump stations. In addition to the two pumps in each station, there is a solenoid controlled dump valve. The entire system is electrically interlocked, providing automatic sequential starting and stopping. The eight pump stations successively reagitate the slurry as it moves up the slope. This was preferable to a single pump station at the mill containing one positive displacement type pump or 16 centrifugal pumps. Capital expenditure and operating costs also favored the choice of several centrifugal pump stations located along the pipeline.

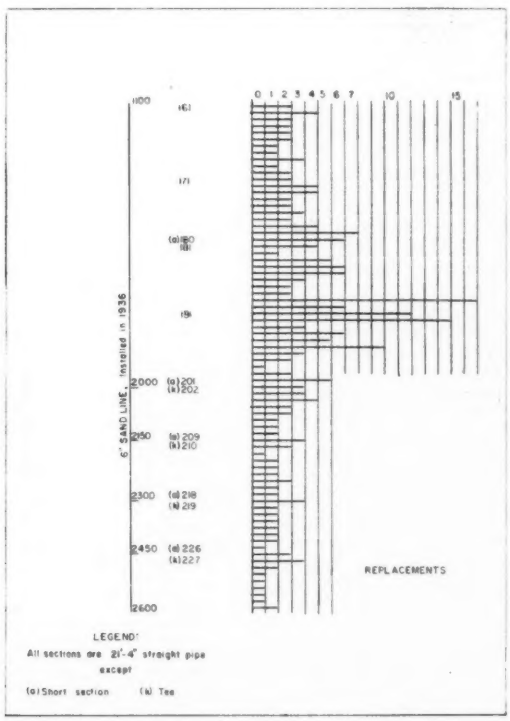


Fig. 3. Pipeline replacements in vertical six-in. sand line between 1100 and 2600-ft levels at Homestake mine: note increased wear in higher portion where pulp has a free fall. Bottom portion fills with pulp in overcoming friction head of horizontal runs, thereby reducing velocity and wear

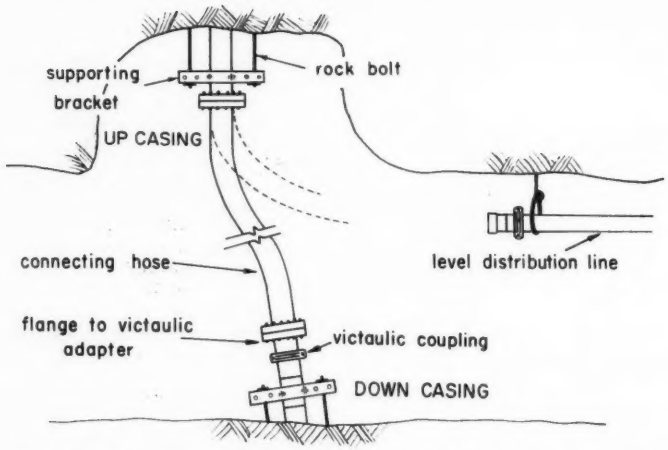


Fig. 4. Typical connection between two diamond drill holes which are used to transport fill underground in place of pipes at Falconbridge Nickel Mines Ltd. in Canada. Initial cost was less, maintenance costs have been very low at level connections, and the holes have required no maintenance while conducting over 600,000 tons of fill to working areas

An interesting development has occurred in some Illinois silica sand plants. They found that it required excessive power to pump their clean slime-free silica sand uphill through sloping lines as compared with replacing them with horizontal and vertical runs. Apparently the problem lies within slopes of 30 to 70 degrees above the horizontal. If the pipe is inclined within that range, the larger and heavier solid particles will settle to the bottom, then slide down the slope and choke the pipe further down To emphasize the point, reference is made to the 108-mi coal-pumping pipeline in Ohio. An article in the April, 1957, issue of *Coal Age*, reads:

> "Inasmuch as the line goes over hilly terrain, it was necessary to limit the maximum inclination. If it was too steep, the coal would have a tendency to roll back even though the water continued on its path. The maximum inclination permitted (in designing the pipeline) was 10 degrees."

Homestake Guards Against Pipe Wear

At Homestake Mining Co, Lead, S. D., hydraulic back-filling of underground workings started in 1937. Since its inauguration, ground movement has been greatly retarded. During the year 1957, their sand had a specific gravity of three, and averaged 40 per cent minus 200 mesh, with a percolation rate of 2.4 in. per hr.

The main slurry supply line from surface to the 1100-ft level is a vertical six-in. iron pipe lined with ¼ in. of abrasion resistant rubber. The sand is transported by gravity through a series of vertical and horizontal pipelines from the surface to a maximum depth of 4100 ft and horizontally for a maximum distance of 4360 ft.

An average of 174 tph of sand is transported during the running time at a pulp density of 58 per cent solids. Care is taken to prevent air from entering the pipeline. No valves are used; instead, rubber covered discs and blanks divert the slurry flow through the desired pipeline Recently a special box was developed permitting the insertion of the blank or orifice from the side without removing the flange bolts.

In the upper part of the vertical sections of the line the pulp has a free fall, while hydrostatic pressure builds up in the lower part. The height of the pulp in the bottom of the vertical pipe varies with the friction head that must be overcome in the horizontal runs. The pipeline is always full in the horizontal sections while running sand, thus minimizing wear with moderate velocities. However, in the upper portions of the vertical lines, where sand is free-falling, the velocities are very high and wear is severe. (See figure 3.)

It is desirable to install vertical pipelines absolutely plumb, using a transit, because wear will occur at any misalignment. Long sweep bends of 10 ft radius are used on turns. Wear is much more severe in curves, tees and wyes than straight sections.

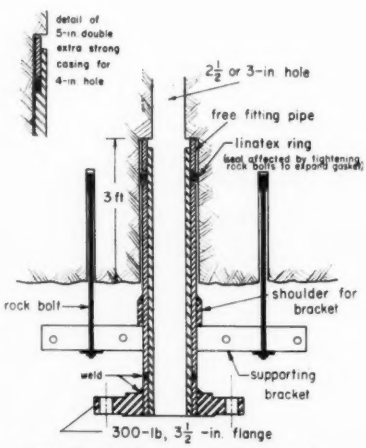


Fig. 5. Detailed view of up casing used for making connections to pulp carrying bore hole. (See figure 4.)

After 20 yr of service, involving over 7,000,000 tons of sand, many of the original sections of pipe are still in service. However, at points of extreme wear, some sections have been replaced several times.

Recent extensions to the system have been made with five-in., schedule 40, steel pipe with ¼-in. rubber lining, using victaulic connections.

Bore Holes Conduct Tailings Underground

At Falconbridge Nickel Mines Ltd. in Canada, it is standard practice to convey tailing fill underground by means of bore holes. (See figures 4 and 5.) Over 13,000 ft of bore holes—six complete conveying systems—have been drilled for this purpose. The total footage consists of: 3000 ft of 2½-in. diam hole, 5000 ft of three-in. diam hole, and 5000 ft of 4-in. diam hole. These operate as closed pipe systems.

The fill is sent underground at about 70 per cent solids by weight. A typical screen analysis is: 50 per cent plus 150 mesh; 30 per cent minus 150, plus 325 mesh; and 20 per cent minus 325 mesh.

Approximately 600,000 tons of fill have been passed through these holes. The deepest bore hole system extends to a depth of 3500 ft.

In planning these installations, rubber lined pipe was considered, but was rejected because bore holes with the necessary connections at 200-ft level intervals could be diamond drilled at less cost than the installation of a rubber lined pipe. Maintenance costs have been very low on the level connections, and the holes have required no maintenance.

Proves Advantageous in Many Situations

Hydraulic filling is used at Chibuluma mine in Northern Rhodesia, where production of 1500 tpd of five percent copper ore started in 1956.

The relatively high grade ore, and the possibility of a difficult drainage problem if the hanging wall strata were disturbed indicated the need for tight filling. Since sufficient quantities of sand could not be recovered from the mine tailing, additional tailing is imported from a neighboring mine. To remove the slime from the tailing, a new plant is being built which will consist of two stages of classification, a hydroseparator followed by hydrocyclones. To date, about 207,000 tons of sand have been placed underground.

Many underground mines must eventually fill stopes in order to avoid loss of ore remnants and prevent ground failures, subsidence and rock bursts. Hydraulically placed thickened mill tailing has several advan-

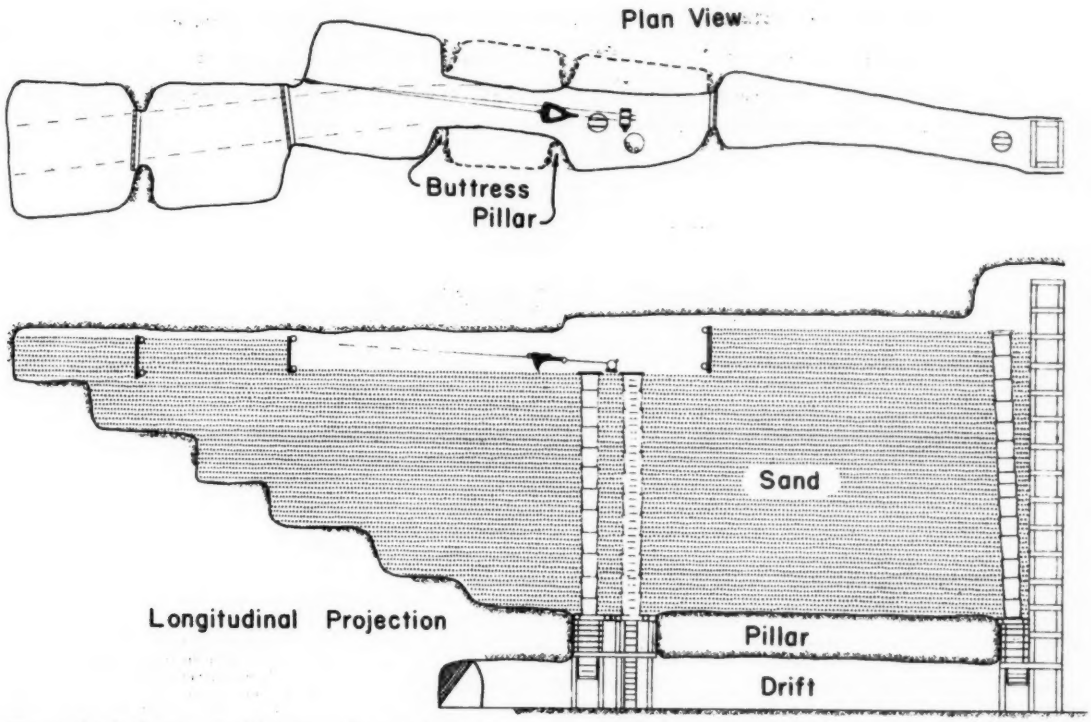


Fig. 6 Steel pipes are used for down chutes and auxiliary manways at the Dayrock mine of Day Mines Inc., Coeur D'Alene District, Idaho. Buttress pillars are left to decrease the area of timber bulkheads in wide veins where unstable wall conditions make it necessary to fill immediately after mining.

tages. It permits much greater flexibility than a waste rock fill, since fill can be poured on a very flat dip or even piped vertically up a blind raise to heights of 100 ft or more.

With good wall rock, it is possible to delay the filling operation until stoping has been completed. Then a block type fill is poured after sealing all down chutes with concrete bulkheads. Block fills are used with open stoping methods such as: shrinkage, sublevel, and room and pillar. The objective of the hydraulic fill is to stabilize a large block of ground and prevent ground movements and the possibility of rock bursts and air blasts. After consolidation and cementation, pillars or stopes may be mined adjacent to the fill. (See figure 6.)

In heavy ground conditions at the Mt. Con mine, in Butte, Mont., horizontal cut and hydraulic fill stoping, with rock bolts and air leg drills, was substituted for the historic square set timber methods. (See *Mining Congress Journal*, Oct. 1958.) The savings in material and labor reduced the relative stoping cost 30 percent and increased efficiency by 54 percent, to over 14 tons per man-shift.

With filling integrated into the stoping cycle, it permits a faster filling cycle; hence, a faster mining cycle which produces more tons per unit time and dollar invested. The shorter mining cycle time improves ground conditions, which usually permits use of a less expensive mining method.

Apart from these considerations, it is well worth pointing out that several tests were made at the Mt. Con using a polyelectrolyte flocculant added to the fill slurry. Initial tests indicated improved settling of the fine particles yielding higher percolation rates and clearer supernatant liquid. Thus, the water drained from the stope contains less solids.

Mine Fire Control Possible

Hydraulic filling is important as a means of preventing, controlling, or extinguishing underground mine fires. This method is particularly adaptable to large, inaccessible mine fires where temperatures are high.

The Anaconda Co. first used this method in 1917 to extinguish a stubborn isolated fire in the Minnie Healey vein. The fire zone condemned a high grade block of copper ore 1000 by 1200 ft in horizontal area, extending vertically from the 600 to the 2200-ft level. Nearly 1,000,000 tons of tailing was required to control this fire.

Since 1917, hydraulic filling has been used extensively in Butte to fight fires, to stabilize blocks of ground prior to mining, and to fill stopes. To date, nearly 8,000,000 tons of fill has been placed by hydraulic methods.

BIBLIOGRAPHY OF HYDRAULIC STOPE FILL SYMPOSIUM

Preparation of Mine Backfill Using Wet Cyclones, by R. T. Dottery, Mountain Industrial Division, Dorr-Oliver, Inc.

Pilot Plant Study of the Transportation of Hydraulic Back-Fill Slurries at Montana School of Mines, by George L. Wilhelm, U. S. Bureau of Mines research fellow, Montana School of Mines

Transportation of Slurries in Pipelines, by Fred L. Smith, manager, and Thomas R. Young, Mining Division, Colorado School of Mines Research Foundation

Practical Approach to the Design of High-Head Transportation Systems, by W. B. Stephenson, president, Allen-Sherman-Hoff Pump Co., and representative of the Hydraulic Institute.

Sand Filling at Homestake and Associated Problems of Pipe Wear, by C. N. Kravig, mine superintendent, Homestake Mining Co.

The Use of Bore Holes for Conducting Classified Tailing Underground, by H. F. Beattie, engineer in charge of mine research, Falconbridge Nickel Mines Ltd.

Sand Filling at Chibuluma Mine, Northern Rhodesia, by J. P. Norrie, consulting engineer, and H. L. Henry, formerly underground manager, Chibuluma Mines Ltd.

Hydraulic Stope Fill Permits Specialized Mining, by Rollin Farmin, assistant general manager, Day Mines Inc.

Details of the Hydraulic Fill Mining Method Used at the Mt. Con Mine, Butte, Montana, by John M. Suttie, mine superintendent, The Anaconda Co.

Laboratory Investigation of Flocculation and Mine-Scale Investigation of Flocculation in Hydraulic Back-Filling, by Donald L. Cenis, design engineer, Western Nuclear Corp.

Use of Hydraulic Filling in Preventing or Fighting Mine Fires, by H. A. Wendel, chairman of Bureau of Safety, The Anaconda Co.

Economical installation . . . reduced fuel costs . . . increased efficiency of applied horsepower . . . advances in dust handling and control . . . engineered "package" plants . . . these features highlight manufacturers' efforts to improve thermal drying equipment

Recent Advances in COAL THERMAL DRYING

By F. R. ZACHAR

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Morgantown, W. Va.

EXCEPT in cases where an operator needs to pre-dry his plant feed, thermal drying usually appears at the tail end of a plant flow sheet. This tail end position is characteristic as thermal drying also is relegated that position in the minds of those responsible for the selection of the various processes by which their coal will be handled in the pre-design stages of a plant. No one wants to heat-dry coal; it is only when all efforts to avoid it have failed that heat drying is elected. The reason for this, of course, is the added cost, both maintenance and operating, incurred in carrying out the process.

Manufacturers of coal thermal drying equipment have long since recognized this objection to their product, and have been conscientiously endeavoring to improve their designs and methods employed. As a result, relative cost per ton of thermally dried coal is now considerably lower, on the average, than that of not too many years ago.

O. R. Lyons, in his 1947 paper "The Thermal Drying of Coal," lists the following characteristics as those necessary to a good drying system: (1) an ample supply of hot gases at a temperature at, or only slightly above, the critical temperature of the coal being dried; (2) retention time of the coal in the drier to be the minimum that will allow adequate evaporation; (3) maintenance of the exhaust gases at a temperature high enough to prevent condensation prior to leaving the drier; (4) ability to treat a relatively wide range of sizes without overdrying; (5) a method of providing intimate contact of the hot gases with the coal to be dried; (6) high thruput of coal; (7) high thermal efficiency; (8) a design that will keep maintenance at a minimum, and (9) simplicity of operation and control. Certainly, these characteristics are those desired and are those toward which manufacturers are constantly striving in their efforts to improve their respective units.

While the title of this article implies discussion of new methods and new types of equipment, the writer feels that mechanical, electrical, and control improvements introduced or applied to any and all dryers are definitely advances in the science of thermal drying and will be discussed at length herein. It is certainly worth recording design changes that contribute to lowering either or both operating and maintenance costs in this high-cost step of coal preparation.

Thermal dryers used in the coal industry may be classified into seven general types:

1. **Rotary; with either inner and outer shells, or an outer shell with lifting vanes inside**
2. **Screen type; wherein hot gases effect evaporation passing through coal conveyed by a reciprocating screen**
3. **Cascade; in which coal flows in steps down through a series of stationary or revolving shelves. The Turbo-Tray drier may be classified as one of this type**
4. **Continuous carrier; in which the coal is moved through the drier on a wire mesh belt**
5. **Suspension or "flash;" in which hot gases evaporate water and convey fine coal up a drying stack**
6. **Multi-louvre; in which hot gases are passed through a falling curtain of coal. Coal is raised by ascending flights of a specially designed flight conveyor**
7. **Fluidized-bed; in which the coal bed is suspended in a "fluid" state above a perforated plate by a rising current of hot gases. Each coal particle is surrounded by a film of air and discharge is by weir overflow.**

Fluidized Bed Dryers

Utilization of the fluidized bed process for drying fine coal is a relatively new development. This process has been used successfully for many years in roasting ores and with refinements has been successfully applied to the coal industry's problem of drying the finer sizes.

The process was developed with the aim of offering a drying system of high drying efficiency, short detention time, high capacity per unit area, versatility as to sizes that can be dried, ease of control, and low maintenance. Fluidized bed driers are offered by two companies and their products will be discussed individually.

Dorrco Fluo-Solids System. Figure 1 (left) shows the general arrangement of the Dorrco Fluo-Solids Sys-

tem of Dorr-Oliver, Inc. Coal to be dried is fed by screw conveyor onto the perforated construction plate and is subjected to the passage of hot inlet gases blown upward thru the plate and coal bed. The fluidized bed is dried and coarse material discharged over the weir and thru the discharge gate. Fine material is carried with the exhaust gases into the cyclone system where coal particles are precipitated and drawn off as fuel or mixed with the dried product.

Considerable improvement has been made in the methods whereby inlet gases were heated in the original installation in 1955. A hot sand bed was used for conbustion of fine coal and pulverizers were not used. Changing to pulverizers and using pulverized fuel eliminated firing within the drier at shutdown. Original pulverizers were very precise and maintenance was very high. These high precision units required hot air to be blended with feed coal to insure its dryness. Less expensive pulverizers were adapted and the necessary air blend for drying fuel eliminated. Changing pulverizers permitted pulverizer blower pressures to be dropped from 4.5 psig to 2.0 psig. Elimination of the sand bed and utilization of pulverized fuel contributed to reducing the main blower pressure from 4.0 psig to 1.5 psig. The original fuel bin was pressurized but operating experience has shown that the fuel bed provides a seal and the fuel bin pressurizing system was eliminated. Also, two star gates air locking the fuel bin have eliminated the table feeder formerly used to feed the pulverizer.

Original installations utilized wrought stainless steel bars made up into the construction plate. Current practice is to use punched or slotted plate and it has been found that higher inlet gas temperatures are now more acceptable.

The original charged feed chute has been greatly improved, eliminating a large expansion joint, and permitting all feed screw conveyor bearings to be outside the dryer rather than in higher temperatures.

The restriction plate overflow gate is now controlled by an air operated cylinder in turn controlled by the pressure differential thru the construction plate and coal bed. This feature permits uniform bed conditions.

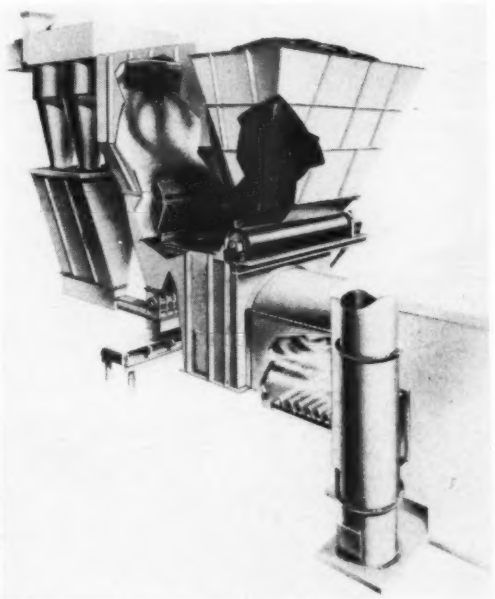
Thorough instrumentation with improved control equipment has increased efficiency of operation and gives operating personnel detailed information. Danger of firing in the dryer has been decreased, cyclone efficiencies have been raised, and stack discharge has been bettered by control improvements.

Originally designed for drying ¼ in. by 0 coals, the system has given positive indications of being able to dry 1½ in. by 0 coals with equal efficiency.

Fluid Bed Dryer. General arrangement of the Heyl & Patterson, Inc. Fluid Bed Dryer is shown in figure 1 (right). Coal to be dried is fed by roll feeder onto the bar-type restriction plate and is subjected to hot gases drawn up thru the plate and coal bed. The fluidized bed is dried and coarse material drops into the discharge hopper. Fine material which does not settle out in the main drying chamber is carried over into the dust collector where it is removed and used as fuel or mixed with the dried product.

The original unit had a screw conveyor feeding the coal from the feed hopper. This device was eliminated in favor of a star gate which in turn was replaced by a roll feeder. It is claimed that this change greatly improved maintenance of the feed equipment. The feed bin has been suspended by springs to permit total bin weight to control the gate opening to the roll feeder. This feature tends to eliminate fluctuation in feed rate.

The first units were equipped with a variable discharge gate and operated with a full discharge hopper. Present units operate with an empty hopper and continuous discharge gate. This gives hopper capacity for the coal on the restriction plate when emptying the dryer.



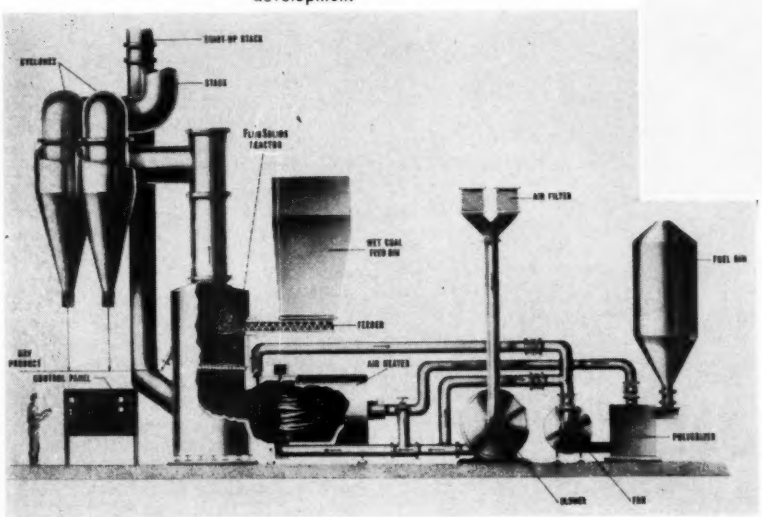


Fig. 1. General arrangement of: (LEFT) Dorrco Fluo-Solids System, and (RIGHT) Heyl & Patterson Fluid Bed Dryer. Use of the fluidized bed process for drying fine coal is a relatively new development

Control equipment has been improved and very thorough study has provided safeguards against firing in the dryer and thruput of wet coal.

Heyl & Patterson is now building a larger size Fluid-Bed Dryer capable of evaporating up to 60 percent more pounds of water per hour than the original unit with only about 50 per cent increase in required horsepower.

Originally intended for minus ½-in. coals, the dryer has operated on feeds up to 1¼ in. by 0 without difficulty.

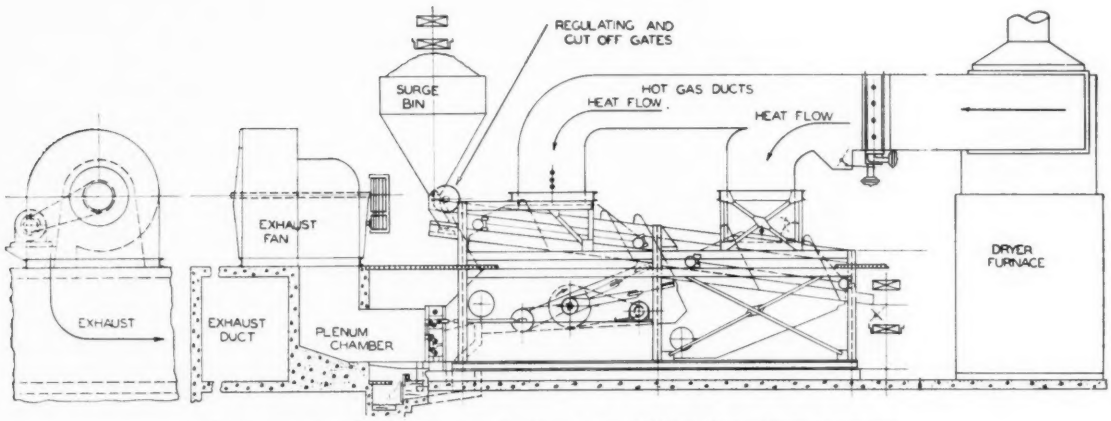


Fig. 2. An example of a screen type dryer is the McNally-Vissac Dryer shown here

Screen Type Dryers

McNally-Vissac Dryer is shown in figure 2. Wet coal feeds onto a reciprocating screen where it is subjected to mechanical dewatering as well as to the passage of hot gases moving downward thru the coal bed. Coal discharging over the primary screen then passes over a second screen where it is subjected to hot gases passing downward thru the bed. Gas pressure is alternately applied to the screens and dewatering is accomplished by squeezing as well as evaporation. This dryer is designed for feeds up to 2-in. top size with ½-mm bottom size, but can dry to 0 in. if the minus ½-mm is limited.

The dryer utilizes no wet coal feeder or dry coal feeder. Seal gates at the upper ends of screens were formerly manually regulated, but have now been counter-weighted and "float" on the coal bed.

Springs have been added to screen hangers, taking considerable load off the eccentric shaft and screen frames. This addition has improved eccentric shaft bearing life.

Hot gas duct louvres have been changed from horizontal shaft to vertical shaft type, decreasing warpage and improving bearing life. Exhaust fan blades are now stainless steel and spiders have been made stainless steel also.

The control system has been continually improved and operation simplified. Air volumes are varied and temperatures maintained in normal operation.

McNally Pulso Dryer is designed primarily for ⅜ in. by 0 feed, but can dry up to two-in. top size. Coal is fed onto the screen deck by rotary feeder and subjected to a controlled pulsating flow of hot gases passing upward thru the bed of coal. Fines falling thru the screen are dried in the hot gases and are taken out by a screw-type discharge conveyor. Coal, dried and passed over the screen, also falls into the screw discharge conveyor or discharged as a separate product. Extreme fines not trapped in the coal bed or passed thru the screen are collected in the expansion chamber of the dust collector. Unlike the Vissac Dryer, all water must be removed by evaporation.

The feeder has been changed from a star type to a solid drum with rotating blades, decreasing hang-up and insuring more uniform feed.

The screen plate can be mild steel punched plate instead of the original woven wire. Maintenance and screen replacement costs have been decreased. Also, the percent open area of a given screen plate has increased as much as 60 percent by elimination of dead plate area.

The steel screw conveyor has been changed to a sectionalized cast iron conveyor, improving maintenance costs and cutting downtime.

Earlier Pulso dryers were equipped with a hot gas fan and an exhaust fan. The former has been eliminated. Also, these dryers formerly were equipped with mechanical means of controlling hot gas pulsation (hence its name), but today's unit has eliminated the mechanical devices and relys on movement of the bed on the screen action to control pulsation. Elimination of the hot gas fan permits the entire system to be under negative pressure and all leaks are inward. The exhaust collecting hood over the screen has been increased and the lower velocity thus attained allows additional fines to precipitate as well as decreases degradation.

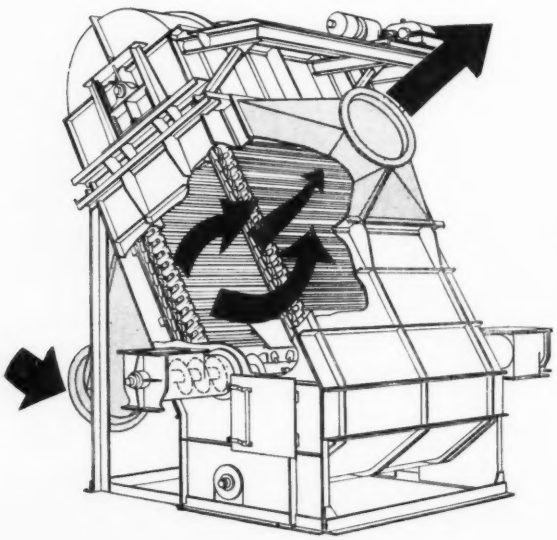


Fig. 3. Link-Belt's Multi-Louvre Dryer consists essentially of an inclined conveyor operating within a steel housing

Multi-Louvre Dryer

Link-Belt Company's Multi-Louvre Dryer (figure 3) consists essentially of an inclined conveyor operating within a steel housing. A feed-discharge screw conveyor introduces wet coal into one side of the dryer housing where the wet coal falls into the

inclined conveyor. The coal is then elevated to the top of the dryer and, as the conveyor pans or louvres go around the head sprocket, it spills off the louvres and cascades back to the foot of the dryer. As coal reaches the bottom, it is thrown back into the ascending louvres and at the same time is advanced thru the dryer by the paddle conveyor, which is on the same shaft as the feed-discharge screw conveyor.

Drying is accomplished by convection. As the coal cascades downward, hot gases are passed thru the moving curtain of coal. Evaporation of surface moisture takes place during this contact and the dried coal is discharged by the feed-discharge conveyor at the side opposite the inlet.

The dryer is most widely used with feeds of ¼ in. by 0 or ⅜ in. by 0 coals, but has been used with equal facility on sizes up to 1½ in. by 0.

Most recent improvement in this unit has been the utilization of new abrasion resistant steels for the paddle section of the feed-discharge conveyor. Also, spiral ribbon has been added to the outer edges of the paddles and amperage curve on the conveyor has smoothed out.

This dryer is now being offered in one size larger than the previous maximum. The new size has an evaporating capacity from 18 to 20 percent higher than previous maximum.

Suspension or Flash Dryers

The most recent addition to this class of dryers is that offered by Silver Engineering Works Inc. and known as the Parry Dryer (figure 4). Coal to be dried is fed by specially designed screw conveyor into the drier column where the coal particles are entrained in a stream of high velocity gases from the furnace and carrier thru the column to the primary and secondary separators. Coarse coal slides down the chute and is discharged thru a rotary valve as a dried product. Gases leaving the drier move downward, then change direction 180°, rising slowly to the entrance of the cyclones or secondary separators. This reversal and change of velocity drops out the major portion of coal and only the very fine dust is passed to the cyclones. The fine dust, 80 percent minus 200 mesh or thereabouts, is a good pulverized fuel and most of that product, after collection in the cyclones, is conveyed to the furnace by primary combustion air and burned. The gases flow thru the cyclones to a common stack and are discharged to atmosphere.

A portion of the stack gas is recycled to the furnace for tempering the drying gases. This eliminates use of excess air for tempering and allows accurate control of the oxygen content in the drying system, maintaining an inert atmosphere. The manufacturer considers this recycling quite important and offers test data on one drier showing that with recycling, fuel consumption was 1113 lb of dust per hour and oxygen content of stack gases was 2.7 percent. With air tempering, fuel consumption rose to 1485 lb per hour and stack gas oxygen content rose to 14.1 percent.

The manufacturer also offers some interesting test data on degradation in a dryer handling 100 tph of 1 in. by 0 coals, indicating that the average particle size decreased only from 0.337 in. to 0.300 in. in the drying operation.

One dryer is now being installed in Illinois to lower the surface moisture of 200 tph of 10 mesh by 0 coal for air table feed.

Several important changes have been made since the original design of the system. The primary and secondary separators are now standard package units and can be shipped as such. A common stack is now utilized for the bank of secondary separator cyclones. The inside of the primary separator is lined with an epoxy resin resistant to abrasion and corrosion. Electrical controls are now standard and complete.

Raymond Flash Dryer

In the Raymond Flash Drying System of Combustion Engineering, Inc., wet coal is delivered to the double paddle mixer type wet feeder by which it is conveyed and continuously introduced into the hot gas stream. (See figure 5.) Instantaneous drying occurs and the dried coal and moisture laden gas are drawn into the cyclone collector. The dry coal is separated out and passes to the bottom of the collector where it is in turn discharged as dried product thru a rotary airlock. Moisture laden gases are discharged to atmosphere or secondary dust collection by the exhaust fan. If an extremely wet feed is to be dried, a portion of the dried product is returned to the paddle mixer and used to condition the feed. The dryer has been designed for

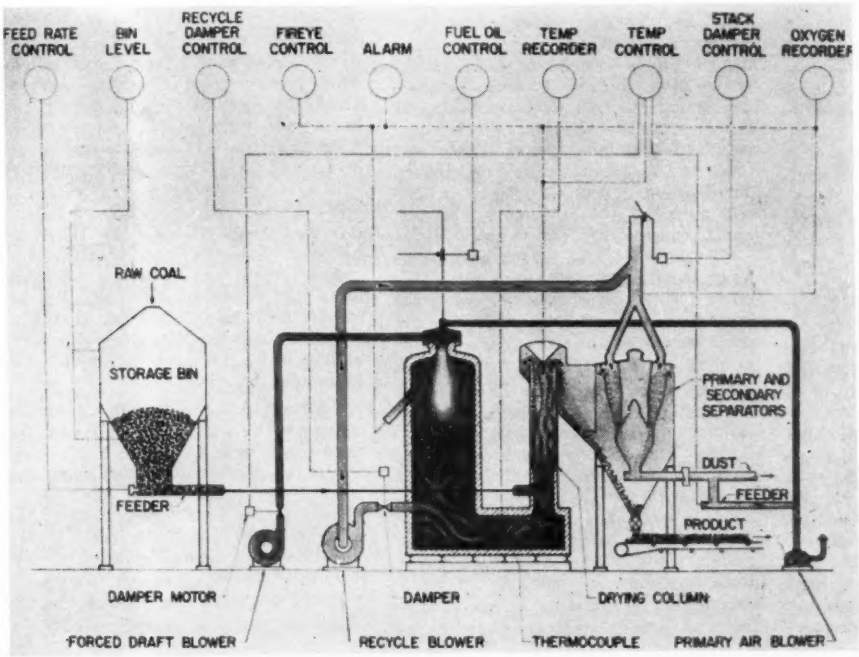


Fig. 4. The most recent addition to the line of suspension flash dryers is the Parry Dryer, which is manufactured by Silver Engineering Works, Inc.

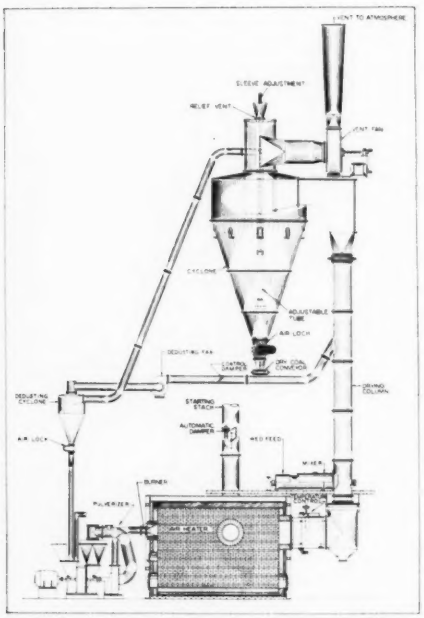


Fig. 5. The arrangement of Combustion Engineering's Raymond Flash Drying System for fine coal shown here has a dedusting system to reduce the vent loss of the standard set up

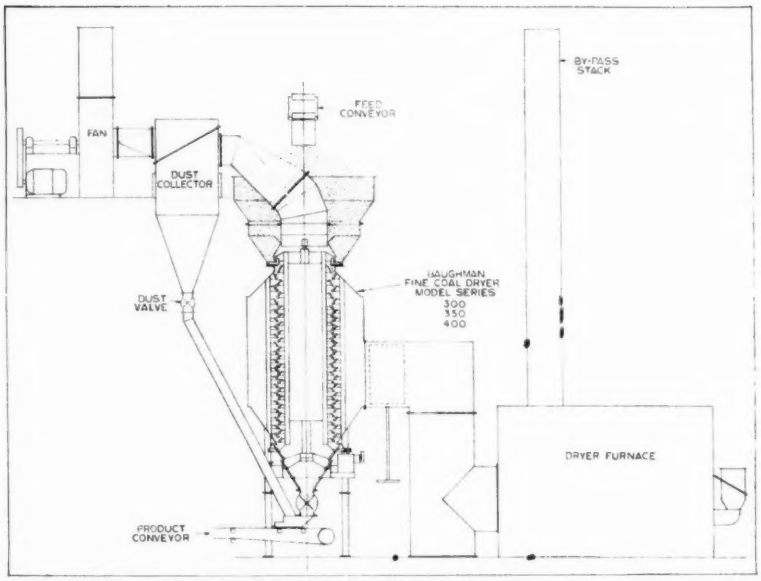


Fig. 6. The Baughman Verti-Vane Dryers, series 300, 350 and 400 have been designed for fine coal sizes. The units are of recent design and although similar to the company's 7 x B model in many respects, they differ greatly in performance and mechanical design.

feeds in the ⅜ in. by 0 size range.

The paddle mixer type feeder has replaced the original screw feeder due to the increased amount of extreme fines being recovered and to be dried. These fines have increased the surface moisture of many feeds and the double paddle mixer was developed to condition those high moisture feeds for pick up by the hot gas flow. In many cases, feed is sufficiently wet to require the recirculation of a portion of the dried product.

A special coal trap (not shown) has been developed to meet the need for a fine coal dryer which would handle very soft coals without degradation. Test data with a full scale field installation indicates that the over-all degradation is practically zero.

The C-E Dedusting System shown in figure 5 was developed to reduce the vent loss of the standard system. Vent loss from a cyclone usually is minus 200-mesh material of high ash content, and the idea behind the dedusting system is to simply and efficiently remove as large a fraction of these ultra fines as practical and burn them to supply heat for drying.

Originally the shaft of the shut-off damper was in a horizontal position and required water cooling to prevent warpage. This shaft is now vertical and a distinct improvement.

In the original designs, a rounded contour elbow was used at the cyclone inlet. Although this was lined with abrasion resistant material, it was found that the wear was considerable. A flat inlet elbow has been substituted as shown in figure 5. This design greatly reduces the wear and makes it possible to easily replace the wearing parts which are simply abrasion resistant flat plates.

Cascade-Type Dryers

McNally Cascade Fine Coal Dryer. Wet coal is fed to the McNally Cascade Fine Coal Dryer (figure 6) by rotary feeder. The coal drops onto shelves which are arranged like a staircase, and as the shelves vibrate, the coal cascades down thru them where it is subjected to hot gases drawn upward thru and between the wedge wire shelves. Fine coal carried up the exhust riser with the hot gases passes into the cyclone collector and is withdrawn by the screw collecting conveyor at the bottom of the cyclone. The system is designed for ½-in. top size material and feed moistures cannot be much over ten percent.

The number and length of shelves have been increased to increase retention time. The shelves themselves have been improved by stiffening the shelf supports and adding air scoops to permit increased air passage.

Baughman Verti-Vane Dryer. The Baughman 7 x B Dryer of Robert Holmes & Bros., Inc., has been designed for coarser feeds such as 2-in. by ½-in. Wet coal is fed by conveyor to the feed hopper and distributes itself the full circumference of the unit by being fed onto the first circular revolving shelf. It moves downward in a zig-zag circular column via alternating inside revolving and outside stationary shelves to the bottom of the unit where it is metered out by rotating plows. This is not a cascading dryer in the true sense, but is included in that class in this article by choice. Hot gases are passed thru the falling circular column of coal to the center chamber and resulting moisture laden gases are drawn thru the exhaust fan and discharged to atmosphere.

Revolving and stationary shelves have been steepened, thinning the bed and increasing the capacity of the unit. Also, these shelves are now made of stainless or other high quality steels.

The dried coal removal plows have been moved to the center sections from the outside section, permitting automatic removal of fines carried over and dropped to the bottom of the center section. This carryover was formerly removed periodically by hand-operated gates. This, of course, readily permits the use of this dryer for coal down to 0-in. if necessary.

Feed ring can now be adjusted while the dryer is running. Adjustments are made from an external position whereas the dryer formerly had to be shutdown to make this adjustment.

Another Baughman Dryer, shown in figure 6, has been designed for finer sizes such as ½-in. by 0. This dryer is offered in three sizes, the "300", the "350", and the "400". These units are of recent design and while generally similar to the 7 x B in many respects, differ greatly in performance and mechanical design.

Plows and plow table are at the top

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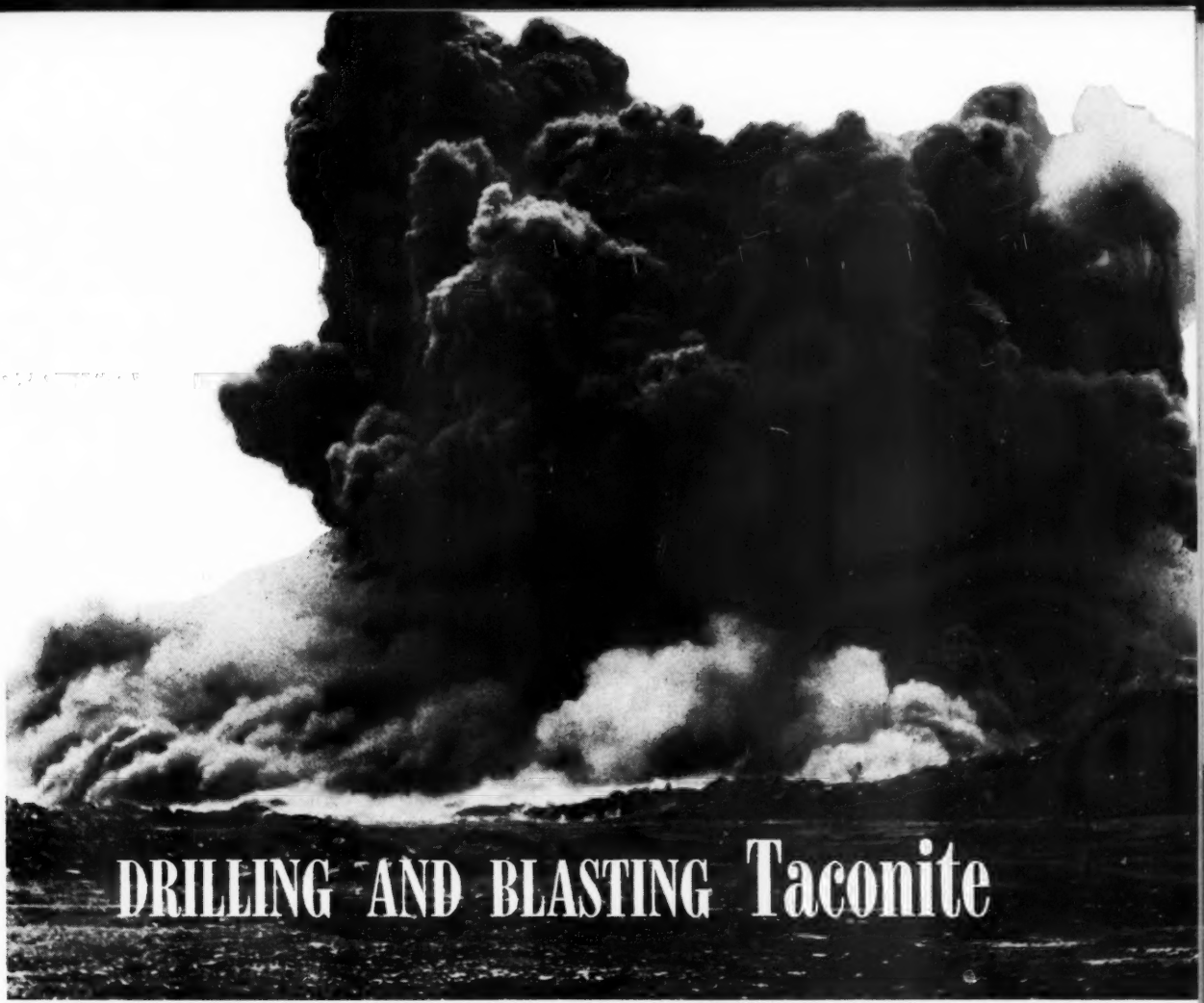


DRILLING AND BLASTING Taconite

Fig. 1. It has been found that larger blasts give better fragmentation. Here 628,000 lb of explosives, distributed in 794 holes, is producing 1,140,000 long tons of muck in one of the largest non-atomic blasts on record

Use of the jet piercer drill . . . careful choice of blasting pattern . . . and strict attention to loading of explosives. . . . Combined, these techniques perform the difficult task of breaking the extremely hard, tough taconite at the Peter Mitchell mine, so that it's easy to load and doesn't cause excessive wear on shovels and crushers

By FLOYD W. ERICKSON*

THE Peter Mitchell mine of Reserve Mining Company's Babbitt Division lies at the easternmost end of the Mesabi Iron Range and consists of low grade magnetic taconite. The ore deposit is nine mi long, an average of 2800 ft wide, and 175 ft deep at the thickest part of its wedge shaped cross-section. The estimated reserves in this area are 1½ billion tons of magnetic taconite averaging 24.19 per cent magnetic iron.

* Formerly manager of the Babbitt Division, Reserve Mining Co.

The magnetic taconite from this area will be mostly from the upper cherty-horizon of the Biwabik formation. It strikes N60E and dips 5½° SE. It consists of irregular elongated bands of magnetite, of varying thickness in a granular, hard, dense cherty matrix. The ore surface is rough with numerous vertical scarps of various lengths and heights with shallow overburden. The taconite at or near the surface is strongly bedded and cut by two systems of vertical joint planes.

Jet Piercer Spalls Rock With Temperature of 4300° F

The taconite rock was found unsuited to the use of churn drills for blast hole purposes by the Mesabi Iron Co. in the early 1920's, because

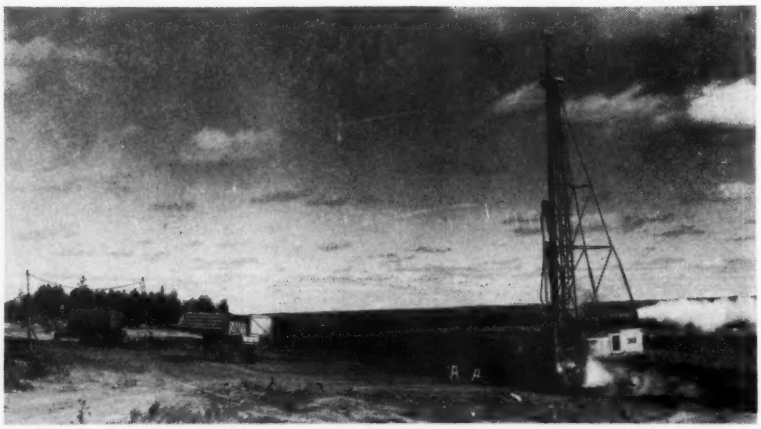


Fig. 2. Jet piercer with oxygen cascade trailer and water wagon: the piercer is burning a 6½-in. blast hole into taconite ore at the rate of 133 ft per shift

of the slow drilling speed of about one ft per hr and short bit-life, about 20 in., between changes. However, the jet piercing machine, using a mixture of oxygen and fuel oil to burn blast holes, which Linde Air Products Company had developed in the late 1940's, was ready for production drilling when Reserve started its mining operations in July 1952. This was tailor made for taconite blast hole drilling.

To produce the blast hole, the jet piercing drill utilizes thermal energy. It is a complicated flame-thrower which produces a tailored flame by a rocket type, triple-orifice burner. It burns oxygen and fuel oil and creates a temperature of 4300° F. The flame strikes the rock and the intense heat causes a thin surface layer to expand and break away as a result of thermally induced stresses. The action of the jets blows the spalled rock out of the path of the flame and exposes fresh surface to the flame. Fusion will occur in broken rock or where the iron band is thick; but depth of melt is shallow and is blown away, quenched and embrittled by the steam and water, or broken up if necessary by the hole sizer and easily ejected. Water acts as a coolant and preserves the combustion chamber. It is discharged near the bottom of the hole where it quenches and embrittles any material that may have been fused by flame. The waste heat in the combustion products produces steam from a large portion of the water which aids in ejecting the cuttings continuously from the hole.

The jet piercing machine, mounted on crawler type tractor, is equipped with a 64-ft mast from which is suspended a 55-ft blow pipe. The blow pipe consists of a swing joint, kelly and burner assembly. Oxygen, water and fuel oil are introduced into the rotating blow pipe through the swing joint. The kelly is a round, triple-fluted pipe which is rotated by an 18-in. turntable located approximately three ft above the ground. Oxygen and fuel oil are carried through different diameter tubes on the inside bore of the kelly to the burner assembly. Water is brought to the burner in the remaining space inside the kelly.

For safety, the gas and steam removal system has been isolated from the main cab to prevent fume leakage into the machine. The cab has also been sealed against fumes and fresh air is brought into the cab from high on the mast via pipe. Electro-mechanical interlocks shut off the burner flame instantly if there is water flow failure. Oxygen flow through the blow pipe cannot be initiated without water flowing at a rate above a safe minimum. Fuel and oxygen piping and hose are different sizes to prevent interconnecting the two lines.

Drilling Rate for 6½-in. Hole Up to 35 Ft Per Hr

Taconite is hard and spallable which makes it possible for a piercing machine to burn a 6½-in. minimum diam hole at a rate as high as 35 ft per hr, to a maximum depth of 50 ft. A hole may be enlarged or chambered with ease at any point where it may be desired to concentrate more explosive. The rate of penetration varies because drilling must be done where blasting has produced back break, through bedding and joint planes, and also because the rock is not uniform but is made up of alternate bands, rich in magnetite or silica.

All blast holes are put down with Linde Air jet piercers using 6½-in. hole sizers. Because of the variations in burning qualities of taconite the average diam of the holes is 9½ in. The overall average per piercer is 133 ft per shift, or 16.63 ft per hr. Thorough cleaning of the rock surface during stripping operations has made it possible to increase burning time of all piercers to 82 per cent.

Oxygen is used at the rate of 550 cu ft per ft of hole, and is delivered to the piercers in cascade trailers which have a capacity of 70,000 cu ft —sufficient for one operating shift. Fuel oil is used at the rate of two gal per ft of hole. Water is delivered to the piercers by 91FD Euclid water trucks and pumped into 4800-gal water wagons. There is one water wagon per piercer, and they are insulated and equipped with immersion heaters for winter operations. Water is used at the rate of 1000 gal per burning hr.

Primary drilling requirements for Reserve's 15,000,000 ton per yr taconite operation are handled by four jet piercing machines operating 20 shifts per week. Labor requirements are 11 men per shift, including two-man operating crews per machine and men for hauling oxygen, fuel oil, and water. A six-man maintenance crew works day shift, seven shifts per week.

The sand blasting effect of the cuttings as they are ejected from the hole during piercing causes erosion of the lower half of the blow pipe or kelly. The blow pipe is then turned end for end so the entire blow pipe will have equal wear before it is rebuilt. After approximately 10,000 ft, the blow pipe is completely rebuilt to size by hard facing. This job is done in our shops using a Lincoln automatic welder, and requires about 48 man-hr. The hole sizer is rebuilt every 250 ft. The life of the burner is 3000 hr.

Production Goals Require Change in Blasting Practice

The height of the faces in the first bench is uneven, due to the rough and variable terrain. The bench height averages about 35 ft. The depth of holes in the first bench varies from 23 to 50 ft. The standard bench height in the second cut is 35 ft.

Early in the operation it was found necessary to produce better fragmentation and pulverization in the pit in order to cut down the load on the crushing plant. The main job then was to determine an effective drilling and blasting pattern. At first, two rows of holes at 19 ft apart were used. Results were poor. Then three rows were tried and finally a single row. Back break in the two and three row blasts was excessive, slowing down the drilling rate; therefore, single row blasts were decided upon. From the start it was recognized that one factor contributing to poor fragmentation was the strong bedding and joint planes at or near the surface. Along these planes of weakness the rock tended to break into large tabular blocks which rode out unbroken on top of a blast. To help eliminate this problem, small 1½-in. satellite holes were drilled around the large blast holes. These holes were loaded, tied in and shot with the main blast.

When production requirements were increased from 1,000,000 tons per yr

to 15,000,000 tons in 1956, single row blasts, with resultant low muck piles, and lost time due to frequent moving of equipment were inadequate. A new drilling and blasting pattern was needed to meet production requirements.

To meet these new requirements a completely new drilling system was put into practice (figure 3A). Box cuts at about 2400 ft intervals were developed along the sides of the initial or "development" cut. Mining proceeds from one box cut to the next, parallel to the development cut. This allows the blasts to relieve in a direction where bedding planes have no adverse effect in breaking to grade. The best fragmentation results when firing a minimum of 10 rows. The burden and spacing have been set at 20 ft, but this basic pattern is varied to suit special conditions. The holes are drilled in straight lines, three ft below grade, and the bottom four ft are double chambered. Double chambering is accomplished by making two extra passes with the jet piercer at the rate of 6 in. per min. This provides for breakage of the rock at the toe and keeps the bottom of the bench on grade. This multiple row pattern has minimized back break, thereby reducing fractured ore in areas to be drilled for succeeding blasts.

Three Basic Loading Systems Used

Waterproof blasting agents are used and can be loaded long in advance of shooting.

Three basic systems, using 0.52 lb of explosive per ton of rock broken, are used for loading holes at Babbitt.

In system number 1 (figure 3B) holes are double primed, using two lengths of reinforced primacord in each hole to prevent misfire. One primer is placed at or near the bottom of hole, the other near the top of powder column. The bottom 16 ft of hole is loaded with heavy density, six by 24-in. cartridges and one primer. Approximately 200 lb of free running blasting agent is poured in to fill the volume around the bottom two cartridges. The next 14 ft are loaded with lighter density powder and one primer, then two ft of heavy density powder and finally stemmed with cuttings from the hole (during the winter months with screened 10-mesh cobber tailings). This system is used in blasts near the crushing plant and shops where it is necessary to keep fly rock to a minimum.

The second loading system (figure 3C) uses a deck load. Deck loads have replaced the use of satellite holes which was a slow drilling and high cost method of breaking the strongly bedded and jointed surface. In areas where scarps are present, the first 32 ft of hole are loaded as in system number 1, then two ft of stemming, a 35-lb primer deck load and stemming. The results in breaking this upper crust are excellent.

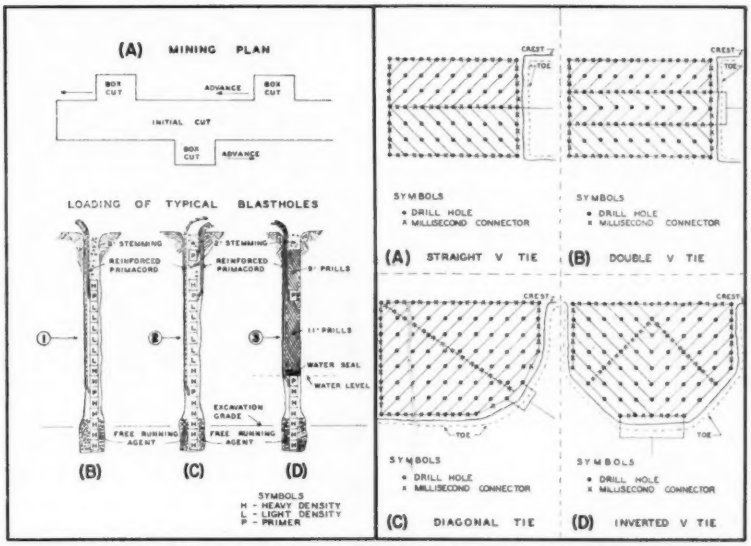


Fig. 3. (LEFT) (A) Mining plan, and (B) (C) (D) the three basic loading systems used, insure that the bottom of the blast is kept on grade and an extension of the toe is not formed. Fig. 4. (RIGHT) Four different methods of tying in the blast are used to meet varying conditions in the mine. Primacord and millisecond connectors are used in each

Ammonium Nitrate 30 Percent of Total Explosives Used

On January 1, 1957, ammonium nitrate prills were tried for the first time. The results were excellent. In all areas where fly rock is not a problem, ammonium nitrate is now used in all dry portions of a blast hole. All holes are loaded past the water level in the manner shown in system number 1, sometimes well in advance of the blast. On the day of the blast, the water is sealed off with three to six-in. chunks of ammonium nitrate. Prills are then loaded (in a ratio of 80 lb of prills to one gal of fuel oil, and to within two to four ft of the collar of hole) stemmed and shot (figure 3D). In the holes that are filled with water, deck loads are used and are loaded in advance of the day of the blast. The results with prills are excellent. For the first six months of 1958, 30 percent of the total explosives used has been ammonium nitrate.

The fly rock which results from either of the last two methods, or combinations of methods, of hole loading is a problem in a confined area. Equipment is moved out of the blasting area approximately 1500 ft, and men are moved away approximately 3500 ft. At Babbitt the time lost in moving equipment and men out of area is no problem as the number of blasts per month are few, because blasts vary in size from 400,000 to 650,000 tons broken. It has been found

(*Continued on page* 43)

Fig. 5. Excellent fragmentation and no backbreak are results of close attention to blasting procedures

OPERATING EXPERIENCES WITH A-C POWER

Lower initial cost, simpler installation, and limited maintenance were major reasons for choosing a three-phase, 60-cycle, 440-volt alternating current system for the Crichton No. 4 mine

By J. H. SHERRARD, JR.
Chief Engineer
and
ANDREW RUSNAK
Maintenance Supervisor
Johnstown Coal and Coke Co.

JOHNSTOWN Coal & Coke Co. has been operating a three-phase, 60-cycle, 440-volt a-c powered deep mine for the past 14 years. Crichton No. 4 Mine in the Sewell Seam in Nicholas County, W. Va., has provided a substantial record of the practicability of a-c operation.

The over-all system provides for service from two power company substations with two metering points and block billing.

To eliminate the question of haulage before it becomes bothersome, the coal transportation system at this operation is entirely by 30 and 36-in. belt conveyor from the active sections to the preparation plant.

Main Substations

The No. 1 main substation, located at the drift portal, consists of three 200-kva, 12,000/2400 volt transformers, connected wye in primary and delta in secondary with 12,000-volt, 60 ampere, fused disconnects on the primary and solid blade disconnects on the secondary. The total connected load on this station is 980 hp, to be increased to 1324 hp upon completion of additional preparation facilities in July 1958. Additional capacity will be provided at that time. Primary power protection is provided at the metering point by Johnstown Coal & Coke with one 7500-volt, 400-ampere oil circuit breaker.

The No. 2 main substation, located near the shaft portal, is equipped with three 333⅓ kva and three 200-kva, 22,000/2400 volt transformers connected wye-delta with 22 kv, 125 ampere, trip link fuses on the primary and solid blade disconnects on the secondary. This station is equipped with 300 kvar in capacitance and with two 250-ampere induction-type voltage regulators, the latter set to maintain 128 volts at the metering point, resulting in 2560 volts main primary for the mine. The total connected load on the No. 2 main substation is 4300 hp from 9 active borehole stations and two stations for surface facilities. Primary power is protected at the No. 2 metering point by one 7500-volt, 400-ampere oil circuit breaker. The total connected load at the property is 5280 hp, or approximately 1.5 hp per daily ton of production.

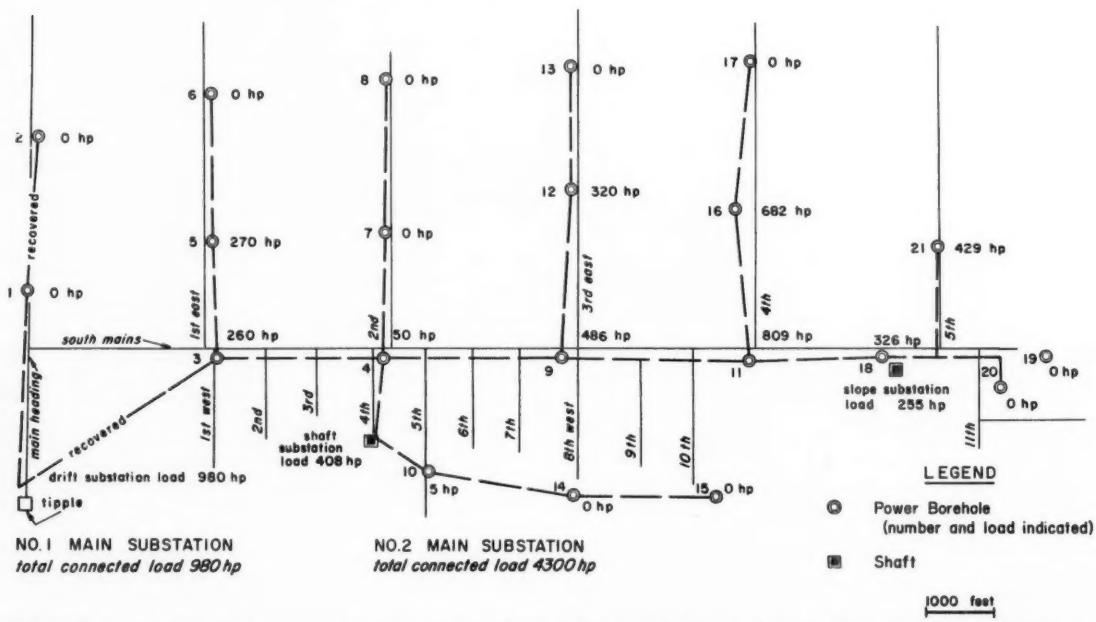
The metering points' loading for the latest month is as follows:

	No. 1 Metering Point	No. 2 Metering Point
KW Load	360	1401.6
RKVA Load	44.8	281.6
KVA Demand ...	263	1430

Maximum connected load for a substation is 809 hp at borehole station No. 11, serving 5 pumps totalling 29 hp, 5 belt head motors with 235 hp, 3 Piggyback conventional mining units averaging 153 hp, and one fault work chainline unit with 86 hp.

Power is supplied from the main substation at 2560 volts by overland 4/0 stranded copper main lines and 2/0 stranded copper secondary lines to surface-mounted transformer stations. One section of surface line between power boreholes No. 11 and No. 18 is 336,400 CM aluminum conductor, steel reinforced. All other conductor is stranded copper.

The overland line is constructed in



Pictured is a plan of surface power line installations and substation connected loads at the Crichton No. 4 mine of Johnstown Coal and Coke Co. in Nicholas County, W. Va.

mountainous timberland, which makes for difficult construction work. Generally the intermediate supporting structures consist of a single class four or five 35-ft pole with 3½ in. by 4½ in. by 8 ft crossarm, and the span is limited to a nominal distance of 200 ft. Where required, two-pole H-frames are used for additional support, but elaborate structures are not made in order to increase the length of span. Dead-ending structures are two-pole H-frames guyed as required until a straight-line extension is completed. The wire spacings on most of the surface lines are 29 by 58 in.

Future construction is expected to be 4-wire, 4160 volt wye-connected primary from a new power company source or by backbuilding at 4160 volts to the present No. 2 metering point.

Surface Stations

All surface stations are equipped with three 100-kva, 2400/4160/120/240 volt, 2300/4000/128/256 volts, or 2400/4160/138.5/277 volt transformers. All transformers purchased recently are 277-volt units with four 2½ percent taps below normal on the primary side.

The transformers are connected delta in primary and wye in secondary.

Eight stations are equipped with 25 kvar capacitors for power factor correction. Four capacitor banks are in continuous operation and four are automatically timed for two-shift operation, the timers being blocked out for weekends. The manually-operated capacitor banks are disconnected on weekends, idle days, and holidays. The timed banks are manually disconnected on idle days and holidays. The capacitors are installed in banks of 3, 6, 9, and 15.

The station is protected on the surface on the primary by 5000-volt, 50-ampere fused disconnects. The secondary protection is by a 660-volt, 60-cycle, 3-pole, 600-ampere General Electric air circuit breaker. The breakers are automatic out, manual reclosing, and on power borehole stations they are located at the bottom of the holes.

Lightning protection is provided on each phase of the primary with 3000-volt pellet-type distribution arrestors installed as close as possible to the equipment.

The company specification for grounding surface installations is that ground resistance is maintained at not more than five ohms by salting soil, providing as many ground rods on six-ft spacing as required, and requiring a minimum size ground wire of No. 6 copper conductor. Moving equipment connected direct to 2400-volt source, such as fan motors and Airdox compressor motors, are provided with not less than No. 1 copper conductor. The fourth wire, borehole casing, and transformer tank ground are tied into a common ground.

The secondary power from these stations is four-wire wye- or star-connected, nominal 480 volts with the fourth wire a continuous grounded neutral from star point to all electrical equipment. Phase to ground voltage is nominal 277 volts. The secondary voltage does vary from 480 volts to 520 volts.

The 480-volt power is conducted to the coal seam on 500,000 CM, type TW, 600-volt insulation copper conductor with 4/0 neutral ground through six in. diameter boreholes cased and grouted to four in. I. D. Maximum borehole depth to date is 703 ft. Average depth is 472 ft.

Power borehole No. 21 recently was equipped with six 100-kva transformers on the surface, and three 750,000 CM copper conductors and one 4/0 neutral ground were hung in the hole to provide for the operation of two Colmol units, one of which will develop to a point 3680 ft from the surface station on 750,000 CM conductors. The second unit will be limited to the usual 2500 from source on 500,00 CM conductors.

Initial Cost of D-C 1.4 Times That of A-C

The surface stations are spaced at 2500 ft from the top of one power borehole to the bottom of the next, permitting 2500 ft transmission and 2028 ft of horizontal mining at the average borehole depth. The total cost of installation of facilities from the dead-end at one substation on 4/0 line for 2028 ft to a surface-mounted transformer station and through a 472 ft borehole on 500 MCM conductors, including 2028 ft of rockbase roadway, is $17,782.80. The unit cost for a horizontal distance of 2028 ft is $8.77/ft. The cost per ton for the 1,330,000 tons of coal recoverable from a single power source in a 40-in. seam is $0.0133.

Comparing this with our d-c operations for continuous mining units, the latter may be extended to 3300 ft from source on 275 volts d-c power. Surface line installation is approximately the same. Boreholes are 8¼ in., cased and grouted to six in. I. D., a minimum of 1000 MCM positive and 1000 MCM negative conductor is hung in the borehole, and a surface conversion installation costing a minimum of $36,000 is required. Total cost is approximately $56,303.00, $19.91/ft, for about 3,000,000 tons of coal. This is $0.019 per ton, or 3.17 times the cost for 2.22 times the recoverable tonnage. Final comparison shows that with our installations, the initial cost of the d-c source is 1.4 times the initial cost of the a-c source of comparable capacity for the same recoverable tonnage.

The tonnage recovered in panel work from one source is not directly proportional to the total distance from the source to the most distant face. Beyond the standard panel length any increase in distribution distance will be utilized in entry feedline installation from which standard depth panels may be driven. Because the additional 800 ft of entry distance gained in the d-c system is more than the original length installed in the a-c system, the available recoverable tonnage is more than doubled with d-c power using the same projections.

The area served by the d-c surface unit requires the total equipment amortization period for total extraction with the connected equipment. Because of this, a direct installation cost-tonnage relationship is used for comparing the two systems.

This initial cost difference, the planned simplicity of installation, and the limited amount of maintenance were major reasons for the choice of a-c in planning the Crichton No. 4 property. Experience has proven these considerations to be valid.

Preventative maintenance required on the surface is extremely little and consists of semi-annual ground resistance tests. Repair maintenance consists mainly of reducing ground resistance and replacing capacitor failures. The latter result from difficulty in voltage regulation, manually-operated banks not being disconnected as prescribed, and occasionally the clocks getting out of time on the automatic banks.

Changeover Considered But Rejected

Within the past few years a changeover to 2300 volt distribution underground was considered, but deemed inadvisable because of the existing transformers on the property, the initial cost of replacing them with permissible load centers, and the lack of flexibility using multiple unit load centers, which would give the most favorable installation cost.

A 336,400 CM steel-reinforced aluminum conductor was used in test in place of 4/0 stranded copper conductor for surface line between power boreholes No. 11 and No. 18. The copper equivalent conductor purchase cost is less, but because of the necessity of installing special and more numerous pieces of hardware—armor rods or aluminum shielding, aluminum fittings, and splices—resulting in more difficult and expensive installation, further use of a-c S. R. is not contemplated.

Distribution underground is by three 500 MCM, type TW, 600-volt insulation stranded copper conductor and 1/0, seven-strand, soft drawn, bare copper ground, suspended on four-in. centers on roof-mounted insulator racks. The underground feedline is terminated at 100-ampere, fused junction boxes in the section areas from which power is carried to

the operating equipment by four-conductor trailing cables varying in size from No. 4 on shortwall mining machines to 1/0 on Colmols. No. 10 four-conductor cable is used for portable pump installations.

All equipment at the property is a-c powered except for d-c cable-reel shuttle cars and battery-powered traction and transportation equipment. The d-c shuttle cars, which are being replaced by a-c cars, are powered from portable 60-hp motor-generator sets.

Difficulty is encountered when starting the a-c shuttle car, empty or loaded, with a full reel of cable, because of the self-inductance in the cable wrapped on the reel. This has been overcome by anchoring the cable at an intermediate point along the shuttle car haulway, permitting only two-thirds of a full reel of cable at any time. No operating difficulty results from this, because the shuttle car haul is limited to 260 ft maximum one way, which limit is amply provided for with 200 ft of cable on the reel.

The a-c shuttle cars have not been in service long enough to confirm the expected benefits of increased "road time" and lower maintenance.

The original substation installations were 128.5/257 volts secondary with a 4½:1 turn ratio. During the war those units were not available, and 120/240 volt transformers were used with taps originally set below normal and augmented by 15-kva booster transformers underground. In addition, 460-volt, 30 kvar capacitors switched with the load were tapped in at the junction boxes on the section to maintain voltage and raise the power factor. A great deal of trouble was encountered in those days because of extremely poor voltage regulation. After repeated failures, the capacitors were removed from the underground system.

Voltage Regulation Greatest Problem

Voltage regulation still is the greatest system problem, although it is not as severe now as it had been in the past. Recent recording voltmeter tests on the No. 1 metering point showed a range of 2550 volts to 2700 volts, with an average of 2610.

Greater than normal voltage drops underground, resulting from extended work, are partially compensated for with 15 kva transformers tapped in at junction boxes on the section.

All underground equipment is protected by a ground fault and overload relays, and in addition to the neutral ground in the four-conductor cable, a visible ground of stranded copper, equivalent to No. 6 conductor, is used for additional safety protection on all equipment except the mobile equipment in the immediate face areas. This is provided to assure protection in the event of an undetected break in the neutral ground inside the four-conductor cable. It is required that this visible ground be connected to each piece of equipment and to the feedline ground before any other cable connections are made.

A 425-ft "manveyor," which travels 150 fpm on a 20 degree slope, is used exclusively to get men in and out of the mine—quickly and safely

Off-face and surface equipment also is powered by the a-c system. This equipment includes pumps from 1 to 30 hp, belt heads from 20 to 75 hp, tipple, shop, office and washroom equipment, three fan motors from 75 to 200 hp, shaft elevator, slope hoist, Airdox compressors, battery chargers, laboratory equipment, and a manveyor. "Manveyor" is the term given to a 425 ft long, personnel transporting, 26 in. wide conveyor travelling at 150 fpm. It is installed in one portion of the 20° slope at the No. 3 portal. It is of interest not because the idea is novel, but, to the best of our knowledge, the application is. The belting is Hewitt-Robins, Inc., three-ply, C. R. 70, with a ⅛-in. corrugated, non-slip top cover and 1/32-in. bottom cover. The alternating current controls are push-button operated magnetic reversing starters with two stations. The drive unit is equipped with a thrustor-operated brake. The unit is used exclusively for transporting personnel into and out of the mine, and results in a shorter length of time in getting man-trips "off the bottom" than has been possible with our shaft elevator at the No. 2 portal.

Advantages of A-C Powered Equipment Cited

To illustrate some of the advantages of a-c powered equipment compared with that of d-c, several examples of similar operations will be cited with breakdown frequency and cost.

The company employs Colmols, Joy loaders, shortwall mining machines, coal drills, roof drills, pump installations, and various other equipment on both a-c and d-c power. The Company has found that an a-c system is more dependable with less examination than its d-c counterpart, and that this reliability is extremely favorable, especially in a-c pumping and hoisting operations.

Maintenance on a d-c machine with its armatures, fields, brushes and brushholders, holder studs, resistances for two-step acceleration, mercury tubes for contactor sequencing, and contactors is more complex and expensive and requires a more highly trained mechanic and a greater amount of preventative maintenance.

A major advantage of a-c motors is the material cost for replacement parts. Almost all a-c motor failures have been in the stator windings because of breakdown in insulation. The rotor of a squirrel cage motor gives very little trouble except that resulting from mechanical failure, such as a broken shaft causing winding damage.

At the present time there are nine Joy 12-BU loading machines operating on a-c and nine on d-c. Using the 12-BU traction motor for comparison, the cost breakdown at current prices for similar repair is as follows:

D-C MOTOR	
Armature, rewound	$ 82.00
Plus Commutator	118.00
Main Fields, set	62.30
Commutating Fields, set	48.80
Brushholders, set	21.10
Brushholder Studs, set	8.35
Brushes, set	3.04
TOTAL	$343.59
A-C MOTOR	
Stator, rewound	$ 65.00
Rotor, new	40.00
TOTAL	$105.00

In addition to this material cost difference of $238.59 per motor, the labor on the d-c unit will require more time, with the resulting increased cost.

Motor Failures Analyzed

The most frequent 12-BU failures on both d-c and a-c machines have been with motor bearings, a mechanical fault, and those resulting from overloading, neither of which can be attributed to a power system.

Bearing failures are due to wear, heat, and contamination in both systems. The heat generated destroys the lubrication of the bearings and leads to bearing wear. That wear, as well as normal wear, destroys the air gap between the rotor and stator, resulting in lower power factor. If the bearings are not replaced in time, the rotor will rub the stator laminations and generate sufficient heat to destroy the coil insulation.

We are required to accept many of the adverse natural conditions, but proper supervision can overcome much equipment abuse.

In three years of Colmol operation, we have had four a-c motor failures and two d-c motor failures. Of the four a-c failures, three resulted from mechanical failure of fan blades which encountered and damaged stator coils. The other failures were due to an inadequate rewind job, which had insufficient copper per coil, causing the motor to overheat and burn off connections.

The two d-c failures occurred on the same 76-A machine because of armature burn-up. The cost of a new armature for replacement and the cost of the rewind were more than the cost of repair of the four failures on the a-c machines.

One cause of a-c motor failure has been an inexperienced operator or mechanic attempting to operate equipment on single phase power resulting from a break in one leg of the feedline or trailing cable or from one contact point being burned or bent so that it fails to make proper contact. We have found that when a single motor indicates phase failure, the section mechanic is inclined to replace the motor without pinpointing the difficulty, and may be placing a good motor into a single phase condition. This fault has been largely eliminated by requiring the mechanics to report a motor replacement to the chief mechanic immediately after completing the work and describing the technique used in locating the fault. This is being done to create procedure habit in the mechanic, as well as to reduce immediate failure of replacement motors.

Contactor trouble is not as frequent in the a-c system as in the d-c systems, but when it does occur without being discovered and corrected, the single phase operation that it causes can be more serious than d-c contact failure.

The ease of reversing direction of rotation of a-c motors by changing any two of the phase leads simplifies motor installation and precludes the necessity of color coding or tagging leads.

The inability of a-c motors to operate at reduced voltages rather than to continue rotation at increased current resulting in baking insulation prevents a great deal of motor failures with a-c. Perhaps this is a blessing in disguise because we are constantly aware that our a-c power must be good.

Safe Practices Must Be Followed in Both Systems

We regret to record that there have been two fatal accidents by electrocution at the Crichton No. 4 Mine. The first was by employee contact with a coal drill which had deteriorated to a non-permissible condition. The second, resulted from a wet working place, a cable splice being pinched by a conveyor chain, and a non-continuous fourth-wire neutral ground.

We do not believe that there are any fatalities built into the three-phase, 60-cycle, nominal 440-volt system, but are firmly convinced that, while less maintenance supervision is required, safety supervision must be 100 percent intense in both a-c and d-c installations.

A-C power installation was considered for a d-c property acquired in 1956. The property was equipped with mechanical mining, loading, and off-track haulage equipment. The estimated cost of conversion to a-c powered equipment and the installation of an a-c system for the remainder of the property, including the maintenance benefits, indicated that a conversion would not be economically sound for the expected life of the property.

Conclusions Favor A-C

Summarizing our experiences, a-c power in our surface system provides for simplicity of installation and repair, a minimum of supervision, and a marked cost decrease in comparison with our d-c systems.

In face operations we have realized definite advantages in maintenance, both in the number of electrical failures and in the cost of those that do occur, with a-c power. Preventive maintenance requirements are not as great as in our d-c systems. Repair and examination work is greatly simplified, and does not require the degree of skill and training required for d-c power personnel. An a-c installation requires no greater safety control—both must be at a maximum.

It is our opinion, based on performance of similar a-c and d-c equipment and total installations, that the most advantageous power system available to the mining industry today in installation, operation, and maintenance is one providing 3-phase, 60-cycle alternating current, with a minimum phase to phase potential of 440 volts.

TACONITE (F. W. Erickson)

(*Continued from page* 39)

that larger blasts give better fragmentation.

Plain primacord is used for the trunk lines. To meet varying conditions in the mine, four different methods of tying in the blasts are used. For shallow banks, the blasts are tied in a single V pattern (figure 4A) using three, 17-millisecond primacord connectors for each interval. The blast is shot in sequence and initiated at center of the V cut. The primacord is detonated using two electric blasting caps. The single V pattern piles the broken rock in the center of the cut 30 or more ft high, which gives the shovels an excellent bank to work in.

For box cuts and development cuts the holes are tied in a double V pattern (figure 4B) using four, 17-ms primacord connectors for each interval. The blast is shot in sequence and initiated at the center of the V cuts. This double V pattern reduces the height of the muck pile and gives a safe working bank.

In corner block locations having two side faces roughly at right angles to each other, a diagonal tie-in pattern (figure 4C) using three, 17-ms primacord connectors for each interval is used. This pattern produces a safe working bank and as the others, an excellent fragmentation.

The final blast, when box cuts meet, forms a peninsula with three open faces. To eliminate cut-offs and lower the height of the muck piles, this type of blast is tied in using an inverted V pattern (figure 4D). Four 17-ms primacord connectors are used for each interval.

Excellent Results Achieved

By using a blast hole arrangement and powder arrangement such as described above, fragmentation reaches a monthly average of over 99 percent usable fragments, leaving less than one percent for secondary work. Over 50 percent of all broken rock is minus 3½ in. This fragmentation has increased the life of the shovel buckets between rebuilds 300 percent, life of dipper teeth from 12,000 tons per set to 31,000 tons. The loading efficiency of the shovels has improved 91 percent. Life of concaves and mantle in the primary crusher has improved 70 percent.

Larger and larger blasts have been achieved—a recent blast of 794 holes broke 1,140,000 long tons of taconite. The holes were drilled in straight lines on a 20 by 20-ft burden and spacing. Holes were loaded as explained in pattern number 1, and were tied in using the diagonal tie-in pattern with 17-ms delays. This blast proved again that, in taconite, larger blasts produce better fragmentation.

By NEILL K. BANKS

General Manager
Texas-Zinc Minerals Corp.

TEXAS-ZINC MINERALS PROJECT

In southeast Utah, Texas-Zinc Minerals Corp. owns and operates an 800-ton uranium mill which treats ores from the company's Happy Jack mine and from over 25 independent producers. The author gives a bird's-eye view of the entire project, from selection of location to operation of the mill

TEXAS-Zinc Minerals Corp., jointly owned by the Texas Co. and The New Jersey Zinc Co., owns and operates a uranium processing mill located on the Navajo Reservation at Mexican Hat in southeastern Utah and the Happy Jack uranium mine located in the White Canyon area of the same state. The principal offices of the corporation are in Grand Junction, Colorado.

Each of the operations is unique in at least one respect: the mill, because a unique method of solvent extraction is employed; and the mine, because it contains the largest known uranium deposit in the White Canyon area.

Mill Site Location Remote But Strategic

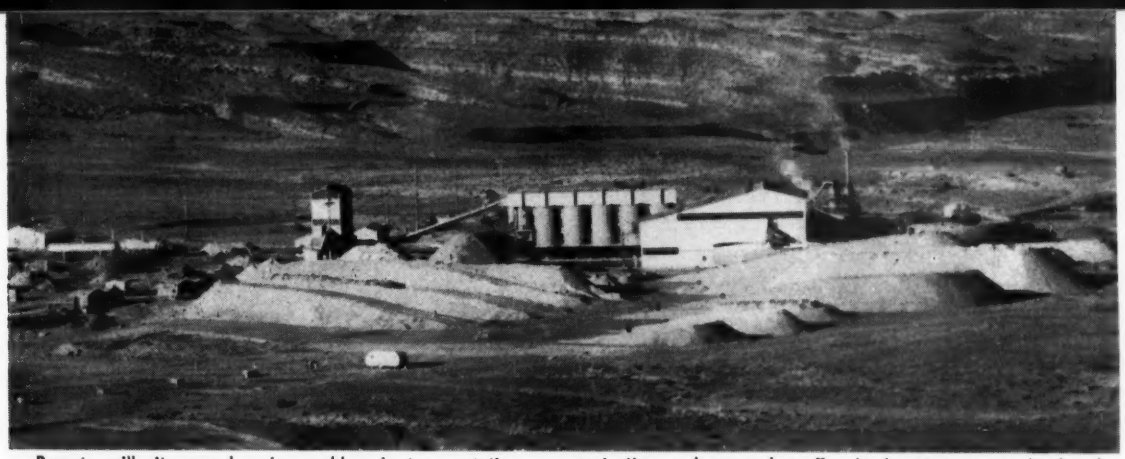
The site for the mill was selected by Texas-Zinc as a location strategically situated to assist in the development of the uranium potential of southeastern Utah and northeastern Arizona. Of prime importance in selecting the site was its proximity to the San Juan River, from which an adequate supply of industrial and domestic water was assured. Other factors dictating in favor of the site were: (1) a mutually satisfactory lease agreement with the Navajos; and (2) preferential treatment concerning mining leases accorded by the Navajos to all millers operating on the reservation.

Selection of this remote site posed some major problems, however, which had to be resolved. The nearest source of power was at Monticello about 75 mi to the north; there was no means of communication other than mail delivery twice a week at Mexican Hat; there was no direct truck route from the mining area to the mill site; and the nearest rail point was 175 mi to the north at Thompson, Utah, with a poor gravel road for the last 55 mi to the mill site.

Consideration was given to construction of a power-generating plant utilizing available natural gas from a point about 25 mi distant. After talks with Utah Power and Light Co. representatives, however, the decision was made to construct a power line; and Utah Power and Light agreed to extend their system southward to Blanding, Utah, about 55 mi from Mexican Hat, and for Texas-Zinc to construct a 69 kv transmission line to the mill site. Of interest to Texas-Zinc was making power available for the development and growth of the whole area. The Stearns-Roger Manufacturing Co. of Denver, Colo., had been chosen as the prime contractor for the mill project, and this portion was subcontracted to the Service Electric Co. of Carlsbad, N. M. Construction of the line was started in February 1957, and it was energized in July 1957. Since construction, Utah Power and Light have obtained service agreements with several of the oil companies and have purchased approximately half the line.

The nearest phone service to the mill site was in Blanding, Utah, 55 mi away. It was highly desirable to have prompt communication, not only between the mill and the Grand Junction office, but also between these two and mobile units attached to the mine and to the geological groups operating in the area. To accomplish this, it was decided to install a radio communication system. Under Federal Communications Commission license, a system of fixed and operational units send and receive by way of base stations located atop of Black Ridge, elev 7000, just west of Grand Junction and Abajo Peak, elev 11,300 just west of Monticello, Utah. The service has been satisfactory in general, with normal inconveniences caused by inaccessibility to service the stations atop the mountains in winter and occasional atmospheric disturbances. Since the installation, the telephone company has installed a microwave system to Mexican Hat, with two channels assigned to the mill site. This will supplement the radio rather than replace it, because, by law, the company is limited to certain types of messages which it can transmit by radio, and must still rely upon radio for communication with the mine and mobile units.

Economic studies indicated that it would be advantageous to provide a more direct trucking route from the



Remote mill site posed major problem in transportation, communication, and power, but offered advantages not to be found elsewhere

White and Red Canyon mining areas to the mill site, not only for company but also for independent mines; and consequently, in mid-1956, construction of this cut-off road was begun. This 33-mi road takes off from Utah State Highway No. 95 west of Blanding and extends southward on top of Cedar Mesa, descending the precipitous 1100-ft rim to the lower flat terrain, where it joins State Highway No. 47 about three mi north of Mexican Hat. The trucking route from the mine to the mill, which formerly went east to Blanding and then south to the mill was shortened by 44 mi. This road was offered to the State of Utah by Texas-Zinc Minerals and accepted in July 1957, as part of the State road system. It is classified as a Federal Aid Secondary Road; and although it is of sand and dirt construction now, there are high hopes that it will be black-topped in the not-too-distant future.

Mine Switches to Surface Operation

The Happy Jack mine is in the White Canyon District of southeastern Utah, 75 mi west of Blanding and 15 mi east of Hite on the Colorado River. The area is underlain by gently dipping clastic sediments ranging from Permian to Jurassic in age. These include:

Wingate Sandstone	**cliff forming**	**300 ft**
Chinle Formation	**slope forming**	**635 ft**
Shinarump Conglomerate	**ore bearing**	**0 - 40 ft**
Moenkopi Formation	**slope forming**	**186 - 390 ft**
Cutler Formation		

No prominent structural features modify the uniform one to three-degree southwestward regional dip, and erosion superimposed on this structure gives a canyon and mesa topography typical of the Colorado Plateau.

The ore horizon in the mine appears to be a "scour" in the Moenkopi formation filled with Shinarump conglomerate, consisting of cross-bedded sandstones, grits, conglomerates, shales, mudstones and siltstones containing variable amounts of carbonaceous materials. There is no clearly defined channel.

The uranium occurs as bedded deposits, as replacements of carbonaceous "trash" accumulations, and as replacements of larger wood fragments. The principal uranium mineral is uraninite, with occurrences of uraniferous sulphates. The ore body varies in thickness from a few ft to over 16 ft, and appears in patches and lenses which thicken and thin with bedding.

Copper minerals, mainly chalcopyrite, occur throughout the mine, but are most abundant in the outermost 30 ft of the workings.

Long known as a copper prospect, the Happy Jack mine was bought as such by the Cooper and Bronson Mining Co. Uranium was discovered in the ore, and uranium mining was started in April 1949, by underground methods. Texas-Zinc purchased the mine in July 1956 to be assured of an ore supply for the mill. Underground mining was continued until April 1957, when the decision was made to mine part of the ore body by a stripping operation. Factors dictating this decision were:

1. **The ratio of overburden to ore in the outer portion of the mine was such that costs were comparable with underground methods**
2. **Dilution of ore would be less than by underground mining in this section because of incompetent back material in the mine**
3. **A large tonnage could be produced in a short time**
4. **Stripping would leave a large level area suitable for mine buildings and facilities when underground mining is resumed**

The Isbell Construction Co. of Reno, Nev., was engaged to accomplish this phase of the mining operation. Work was started in May 1957, and completed in July 1958.

Practically the entire pit was cleaned down to close waste and ore. Separation of waste from ore required the attendance of a technician at all times where the shovel was working, and control was accomplished visually and by use of a "T" probe attached to a geiger counter. Some of the ore was out of equilibrium and it was necessary to employ radiometric assaying techniques, which give separate "Beta" and "Gamma" counts. A total of about 1,000,000 cu yd of material was removed during a period of about fourteen months.

The major portion of the ore body remains to be mined, and it is planned to resume underground operations in 1959. Possibly a long wall retreat method of mining will be used. The known ore body has already been developed by drifts and cross-cuts at not over 100-ft centers.

Copper in Addition to Uranium Recovered in Mill

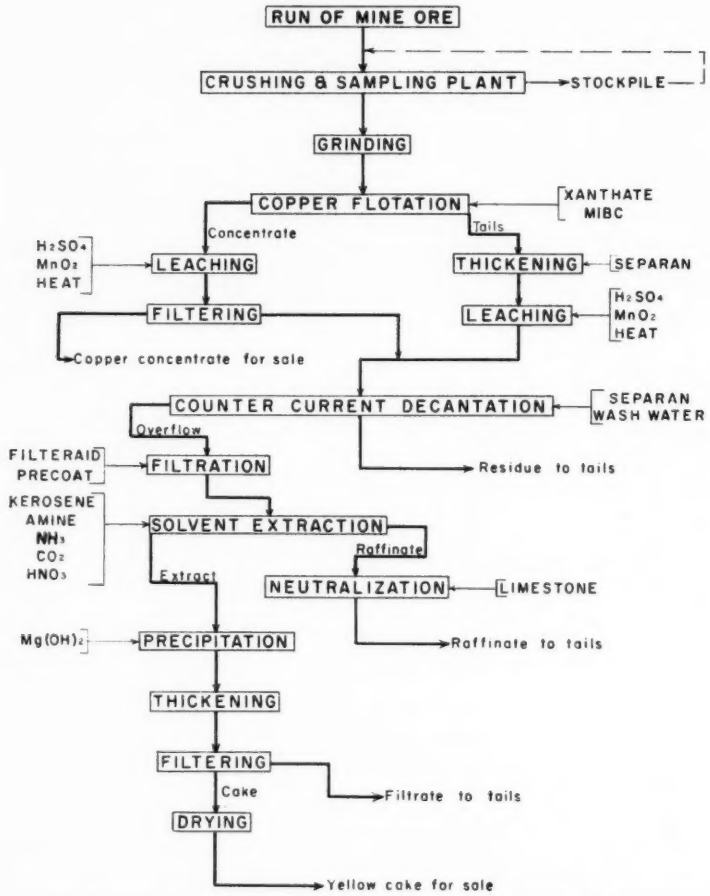
The mill is located two mi south of the San Juan River bridge at Mexican Hat.

The designed capacity of the mill is about 800 tpd, and recovery of uranium is accomplished by the acid-leaching of raw ore and the recovery of solubilized uranium oxide by solvent extraction. Recovery of sulphide copper by flotation is an important secondary objective; and separate leaching of flotation concentrate has indicated, with some ores, that improved recoveries with lower reagent requirements could be expected.

A Leonard-Monsanto 70-ton contact acid plant is operated as an important adjunct, and provides a reliable source of acid and process steam for the mill. Sulphur required for the sulphuric acid plant is hauled molten in specially designed insulated trucks from a point in Wyoming 775 mi. distant.

Amenable low lime ores are received at the mill and accumulated in lots averaging about 300 tons prior to crushing and sampling. Since the start of the operation in November 1957, about 75 percent of the mill feed has come from independent

FLOWSHEET for Mexican Hat mill



Acid leaching and solvent extraction are used for recovery of uranium. Copper sulphides are concentrated by flotation

mines or AEC stockpile, with the remaining 25 percent coming from the company-owned Happy Jack mine. The original contract stipulated that Texas-Zinc process 20 percent of its feed tonnage from independent producers. The modified contract increases this figure to 50 percent. Payment is made on a basis not less favorable than AEC Circular V price, including a lime penalty, when applicable. Payment for copper is provided if ores average over 0.5 percent sulphide copper, although at the present low copper price, ores must contain over one percent copper to be of pay value.

Crushing and Sampling: Sampling of shippers' lots is preceded by two-stage crushing to minus ⅝ in. A 10 percent representative sample is automatically elevated to the sample tower where it receives two successive stages of crushing and splitting to a final sample of not less than 200 lb of ⅛-in. material for any lot.

The analysis of this sample in conjunction with truck weights and moisture determinations of truck samples establishes a basis for payment. From this point on, all lots are co-mingled in stockpiles or process ore bins.

Grinding: Ores are blended from any of four 300-ton storage bins, continuously weighed, pulped and ground to minus 35 mesh in a single-pass five by 10-ft rod mill and an eight by eight-ft ball mill in a closed circuit with a 72-inch spiral classifier. Amyl xanthate is injected to ball-mill feed to give adequate conditioning to slow floating copper sulphide.

Flotation: Flotation is accomplished in ten No. 24 Denver open-type rougher cells, with two-stage cleaning in six No. 18 Special Denver cleaner cells. An alcohol frother is stage-fed directly to the cells, along with additional Amyl xanthate.

Leaching: Flotation concentrate and tailings are directed to separate leaching circuits, the tailings being thickened from 25 to about 55 percent solids in an 80-ft diam by 12-ft high thickener prior to leaching.

Sulphuric acid and manganese dioxide are added to the first leach tank in each circuit, along with sufficient steam to effect optimum leaching conditions. The copper circuit contains three 12-ft diam by 18-ft high leach tanks, and the uranium circuit ten 14-ft diam by 18-ft tanks. All are of wooden construction and are the air-lift agitator type; except the first tank in the copper circuit, which is a turbine type. Leach time in the primary circuit is about 14 hrs.

Leached copper concentrates are filtered in a drum-type filter, and the filtrate is returned to the discharge of the tailings leach circuit.

Washing and Liquid-Solids Separation: The main leach pulp, containing the bulk of uranium in solution, is washed in a five-stage counter-current thickener circuit. The thickeners are 80-ft diam by 12-ft high, and are of wooden stave construction. The pulp is handled by six in. duplex-diaphragm metering pumps. Separan 2610 is added in each thickener to accelerate the solids settling rate.

Pregnant liquor, decanted from the first stage, is clarified in two U. S. pressure-type, pre-coat filters prior to treatment by solvent extraction. The filters are of rubber-lined steel construction, and each contains 22 stainless-steel filter leaves and has a rated capacity of 420 gpm.

Uranium Recovery by Solvent Extraction: The solvent extraction circuit is unique in several respects: Rohm and Haas amine LA-1 is used as the selective solvent in a kerosene base, and centrifugal contactors are used to accomplish solvent extraction.

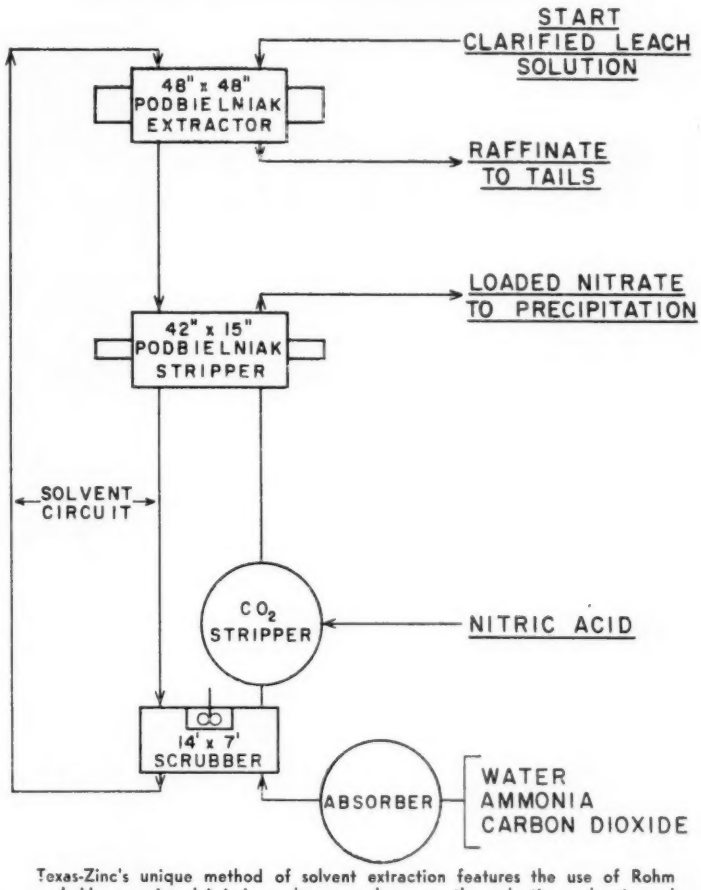
The pregnant liquor containing the dissolved uranium also contains large amounts of various other dissolved contaminants which prohibit consideration of direct precipitation from this solution.

Recovery of the uranium by solvent extraction results in: (1) purification, and (2) concentration of uranium oxide into an acidified ammonium nitrate solution from which precipitation will economically yield a high purity product. Concentration is increased from about 0.8 grams per liter in the pregnant liquor to between 50 and 60 grams per liter in the loaded nitrate.

Purification is accomplished because of the selectivity of the amine carrier to the sulphate complexed anion of uranium oxide. Concentration is effected by varying the amine content of the organic and the nitrate content of the strip solution, subject to flow ratios.

The organic phase consists of between a five and 10 percent solution of amine in kerosene. It is not actually consumed in the process, but is regenerated by removing nitrate from the amine with ammonia; and incidentally, the nitrate thus removed is returned to the process to further displace the uranium complex in the second transfer.

SOLVENT EXTRACTION CIRCUIT



Texas-Zinc's unique method of solvent extraction features the use of Rohm and Haas amine LA-1 in a kerosene base as the selective solvent, and Podbielniak centrifugal contactors. The process involves an ionic transfer of uranium oxide from a pregnant sulphate liquor into the amine-kerosene solution, followed by a second transfer to an acidified nitrate solution

The circuit does not employ the usual mixer settlers for the extraction units, and the design is a significant departure from usual methods. Texas-Zinc has pioneered in the use of Podbielniak centrifugal extraction units for this system.

Presently, the mill can handle 500 gpm of leach liquor, containing about 0.8 grams of U_3O_8 per liter in the larger primary extractor. The stripping operation is conducted in the smaller unit. Within the spinning rotor, leach liquor is contacted with approximately 80 gpm of organic solvent in a continuous and countercurrent fashion. Under optimum operating conditions, a raffinate containing about one part of U_3O_8 per million can be achieved.

Actual residence time of the liquor in the extractor is about 15 sec.

The stripper operates in a similar fashion—continuously and countercurrently stripping the solvent with ammonium nitrate solution, producing a loaded nitrate product containing between 50 and 60 grams of U_3O_8 per liter. The solvent effluent from the stripper normally contains about 0.06 grams of U_3O_8 per liter.

Liquids pass under pressure from the piping to the spinning rotor through hydraulically balanced mechanical seals. The rotors are constructed of 316 stainless steel, and are equipped with heavy duty tapered roller bearings. Gyrol fluid drives provide variable speed adjustment from zero to motor speed. The extractor operates at 1250 rpm while the stripping unit rotates at about 1750 rpm.

The organic solvent (light phase) is pumped to a position near the outer diameter of the rotor—conversely, the liquor (heavy phase) is pumped to a position near the shaft. By centrifugal force, the heavy liquor moves outward, displacing the lighter solvent extract toward the center, thus achieving counter-current flow. The liquids pass through orifices in the contacting elements to effect intimate mixing. Phase separation occurs between the elements, resulting in efficient multi-stage extraction.

Calming sections at the outer diameter and at the center of the rotor provide centrifugally clarified effluents.

The circuit is controlled from a panel. Flows through the entire system are automatically adjusted to the production rate from a single set point of the pregnant liquor flow. Ratio controllers adjust other flows in direct ratio to the liquor flow rate, thus assuring close chemical control of the process with minimum operator attention.

The use of Podbielniak extraction units in the mill has provided a simplified flow pattern in which piping and auxiliary equipment has been reduced to a minimum. Because of this simplicity, 316 stainless steel has been used economically where inferior materials are commonly used.

Moreover, a great reduction in building size was effected through use of these machines.

Another interesting feature of the circuit is solvent inventory. Because of the small volume holdup in the high capacity centrifugal units, the solvent inventory and its attendant expense is held to a minimum. Approximately 3000 gal of solvent is held up in the entire circuit. Of this total, about 100 gal is retained in both extraction units. For a mill of this capacity, employing static equipment, about 60,000 gal of solvent in circulation would be required.

The company is considering the use of other solvents less soluable in the raffinate, and this low solvent holdup will permit conversion with relative ease and economy.

As previously stated, the Mexican Hat installation is the first application of centrifugal extraction units in uranium milling operations. As in most new and radically different designs, certain difficulties were experienced in the initial operation, which were not foreseen from pilot scale equipment. These difficulties were primarily due to capacity limitations, and it was necessary to build a new extractor of larger size. Data obtained under actual full-scale commercial operations provided the basis for modification of the original unit. Following modification, the original unit will be used in standby service.

Mechanical seal difficulties occured during the initial months of operation. Some experimentation was necessary to select more suitable seal materials, and operating experience revealed the necessity for adjustment of hydraulic balance for higher pressure values than were originally estimated.

These modifications have resulted in satisfactory operation since April of this year, and our original estimates of maintenance factors and other operating costs have been reduced to anticipated values.

Product Recovery: Precipitation of uranium oxide is accomplished by neutralizing the loaded acidified nitrate with magnesium hydroxide. The resulting precipitate is thickened, washed and filtered, dried and packaged in 55-gal drums for shipment to the AEC in Grand Junction.

LARGE HAULERS

Conversion to 80-ton tractor-trailer units to transport coal from underground mines has reduced Beckley Coal & Coke Company's haulage cost 80 percent as compared with conventional tandem trucks

By LOWELL E. COPELAND
President
Beckley Coal & Coke Co.

The company has three large haulers: two Dart tractor-trailer units (top), and one unit which has a Kenworth tractor and a Marion Metal Products Co. trailer (bottom). Each hauler carries an average load of about 70 tons, and is characterized by ease of operation, driver comfort, good visibility and maneuverability

BECKLEY COAL & COKE is using large haulers for hauling coal from underground mines. These haulers can easily be adapted for strip mine haulage if so desired.

At present the company has three such machines which can be classed as large haulers: one Kenworth-Marion combination, and two Darts. The Kenworth-Marion has a tractor built by Kenworth Motor Truck Corp., a trailer built by Marion Metal Products Co. The Darts are complete tractor-trailer units made entirely by Dart Truck Co. All three are bottom-dump design of similar size and have many features that are similar, if not identical.

Mechanical Features Big Help to Driver

This description will dwell mostly on the Darts, as they are the company's latest acquisitions. They are equipped with Cummins V-12 Diesels, developing 400 hp at 2100 rpm but could be supercharged or turbocharged to develop much more. The transmission is the new Allison Torqmatic 5640 with torqmatic brake, and is a complete package with torque converter and gearing all in one case. This arrangement saves work for the driver as there is no clutch; gear changing is accomplished by merely moving the gear selector. There are four forward positions and two reverse. The torqmatic brake which is built in these transmissions permit the unit to negotiate six percent grades downhill, fully loaded, at 18 mph in third gear, without using the air brakes. All units have power steering as a further aid to driver handling. Tires on these haulers are 1800 x 25 front, and 1800 x 33 tractor-trailer rear duals. They are tubeless, which seems to be becoming standard on off-highway equipment.

Bottom dump doors are all air-operated and on the Darts are clam-shell type, which means they swing out instead of dropping down as they do on the Kenworth-Marion unit. Trailers on the Darts are 90 cu yd struck capacity, capable of hauling 70 tons of coal as an average load. The approximate dimensions of the Darts are as follows: height 12 ft, width 11¾ ft, and overall length 58½ ft. The approximate dimensions on the Kenworth-Marion are: height 13 ft, width 12 ft, and length 64 ft. They have struck capacity of 95 cu yds, and can haul 75 to 80 tons of coal, but we try to maintain 70 tons as an average load.

Driver comfort is relatively good

on all units, as is visibility and maneuverability.

Haulage Cost Cut Sharply

Terrain at Beckley's operation is typical of mountainous West Virginia. From railroad tipple to mine storage bins, there is one haul of 7½ mi, and from there the same haulroad continues to a distance of 10½ mi. A difference in elevation of 700 ft must be overcome to reach the mines. This is accomplished by climbing upgrade at from six percent to eight percent for a distance of 2½ mi. At that point on to the mines there is an almost level road. The roads are probably average or better, but the author would like to point out that any improvement in haulroads will certainly pay off for these large haulers in less time per trip as well as less upkeep, resulting in lower cost per ton. Because Beckley's operation is at a relatively high elevation generally there is considerable snow and ice during winter months, but resultant problems have pretty well been overcome by use of abrasives on roads and chains on haulers. Rarely is the operation slowed by weather conditions other than fog.

The company has had its Kenworth-Marion hauler nearly two years, and its Darts about five months. At this writing, some spring breakage trouble has been encountered on the Darts, but this should be remedied in the near future by adoption of different size springs.

Since conversion to these large haulers, hauling cost has been reduced 80 percent over conventional tandem trucks, and 35 to 40 percent over 25 to 40-ton bottom dump haulers, with very little difference showing in road requirements.

To sum up, these larger haulers seem to be very practical, not only for hauling from underground mines, but for strip mine haulage as well, and will almost certainly result in lower hauling costs for the user.

COAL THERMAL DRYING

(F. R. Zachar)

(*Continued from page* 36)

of the unit and meter the feed into the drying chamber. The hot gases are therefore pulled thru a vertical, hollow-cylindrical, zig-zag, loose, falling and cascading curtain of coal being metered into the unit. The cylindrical curtain of coal is contained and retarded in its fall by a series of inside rotating vanes and outside stationary vanes. The speed of rotation of the inner rotating section, which carries the plows, determines the tonnage passing thru the drying chamber. A motorized vane feeder at the bottom of the unit of a capacity greater than the tonnage of the dryer serves as an airlock in discharging the coal.

With the 300 dryer, wet coal can be dried immediately on start up and the firing hazard on shutdown has been lessened.

For better drying, the manufacturer has steepened the top shelves, changed to stainless steel shelving, and added a perforated air distribution plate within the dryer.

Turbo-Type Dryers

Turbo-Tray Dryer. The turbine dryer of Buttner Works Inc., was developed quite a few years ago and has had very wide usage in drying inorganic products in Europe. Recently, however, it has been recognized that this unit has excellent application in the coal industry.

Wet coal is fed by adjustable feeder to the top tray of a system of annular trays rotating about a vertical shaft. Coal makes one complete revolution on a tray and then is dropped thru a gap to the tray below. This process is repeated according to the number of trays until the material is delivered from the bottom tray to an outlet chute from the dryer. Flue gases leaving the combustion chamber at high temperature go first to a mixing chamber where they are mixed with recirculated drying gases and are cooled somewhat. The hot gases then pass thru tangential slots in the dryer proper where they are directed to the suction zone of the turbine blowers and undergo another cooling by mixture with circulating gases before coming in direct contact with the coal. Gases coming in contact with the coal may be as low as 150 degrees C.

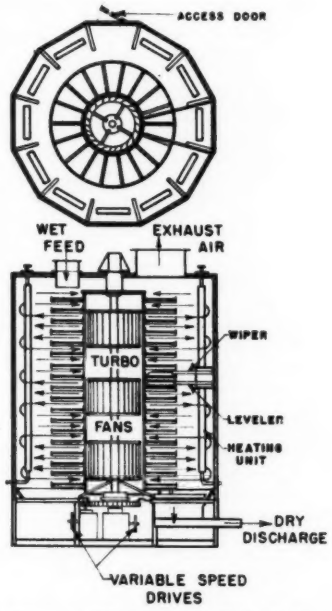


Fig. 7. Wyssmont Vertical Turbo Dryers have been extensively used in this country for many years, but have only recently been offered to the coal industry

The manufacturer offers the following as advantages of this system:

(a) Minimum of waste gas losses.
(b) Low total heat consumption.
(c) Low power consumption.
(d) Ease of inspection and maintenance.
(e) Complete controlability.

The writer knows of no installations in this country, but from data received, it would appear that the Turbo-Tray system is a welcome addition to the equipment now available for thermally drying coal.

Vertical Turbo Dryer. As shown in figure 7, Wyssmont Co., Inc., offers a turbo-tray dryer very similar to that described above. These units have been extensively used in inorganic industry in this country for a number of years and have recently been offered to the coal industry.

The writer is not familiar with this unit, but after reading the descriptive literature of the manufacturer, feels it worth while to list herein some of the manufacturers' statements.

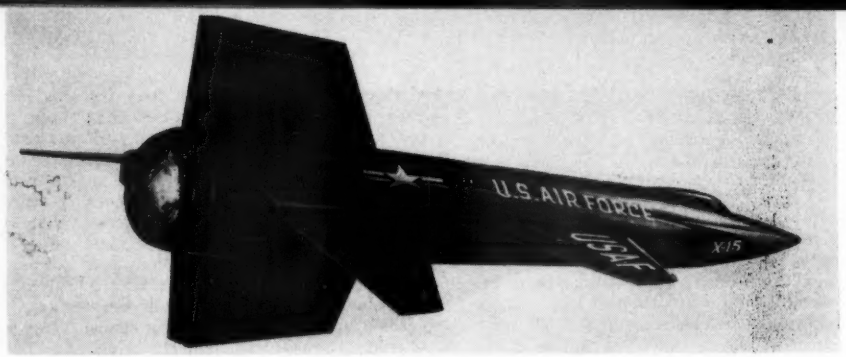
(a) Dust collectors are not normally utilized since wet coals on the top shelf act as a mechanical scrubber.
(b) The design represents the skyscraper idea and requires a smaller floor space for given drying area.
(c) Low horsepower requirements.
(d) Maintenance is low since only two bearings are utilized and these are in the open and available for inspection. A thin layer of material is left on the trays protecting the tray surface against wear.
(e) The unit operates with very high thermal efficiency.

Summary

From the foregoing and other information not included herein, it is apparent that thermal drying equipment manufacturers are endeavoring to provide the industry with high grade, low maintenance, highly efficient equipment to help the operators better satisfy their customers.

Certainly, the drying field is not nearly as limited as in the past and an operator has the opportunity of investigating many more units before selecting the one he feels best suited for his purpose.

It is certainly indicated that thru these improved facilities, the high cost of thermal drying will be lowered and the objections to that process in the preparation of coal reduced.



Aviation is one field which has advanced so far that its further progress is tied to the development of metals and alloys with improved physical properties. Designs for North American Aviation's revolutionary 3600-mph X-15, scheduled for first tests this month, called for a material possessing high strength when cooled to the temperature of the plane's fuel, liquid oxygen (-300° F), and when intensely heated by friction during reentry to the Earth's atmosphere (1200° F). Basic and applied research developed Inconel X, an alloy which meets this formidable requirement

RESEARCH ON NEW USES FOR MINERAL PRODUCTS

Engineering designs are utilizing the physical properties of metals and alloys to a maximum. Significant technological advances now await the development of better materials to do the job

By R. H. THIELEMANN
Chairman, Department of Metallurgy
Stanford Research Institute

IN a few short years, the situation with regard to the products of our domestic mining and metals producing industries has changed from one of scarcity to one of plenty. This was brought about by two factors—namely the ending of severe requirements for materials to fight an all out war and a rapidly changing weapons technology. Because of the devastating power of the new weapons, it seems unlikely, indeed, that we will ever again require the staggering quantities of metals that were needed to build the large armadas of bombers and fighter aircraft that were required for World War II and the Korean conflict. It follows, then, that just as research workers were concerned with the problem of finding ways to conserve the metals that were previously in short supply, they are now working to develop new uses for many of these same metals.

There are reasons to believe that this present situation is a temporary one and, that in the not too distant future, the world wide supply of minerals and metals will have to be significantly increased to meet the demand. Of major consideration is the fact that as the heavily populated, underdeveloped nations become industrialized, their per capita requirements for metals and minerals will increase tremendously. The trend toward industrialization has already started in China and India and it is well along in Russia. Although these countries apparently have the mineral resources to supply many of their needs, there will be competition in world markets for the metals and minerals that are in short supply.

The second important consideration is that our rapidly moving technology will require increasing quantities of many of the minerals and metals for the new applications that are unfolding daily. Many of these new technological developments require new and improved materials for their success. Because of the importance of these new developments to our industrial and economic progress, it is imperative that everything possible be done to make sure that the necessary materials will be available. Although the research effort being expended to develop improved metals and alloys has increased considerably in recent years, greatly expanded programs will be necessary to solve some of the known problems that confront the research workers.

Importance of Improved Materials

In today's world of technological pioneering, increased importance is being given to the development of new and improved materials of all types. This trend is particularly significant in the development of military devices, but the commercial requirements for new and improved materials are just as numerous. Currently, the situation with regard to materials is particularly critical. In practically every field, engineering technology has advanced to the point where the properties of available materials are being utilized to the maximum, and significant engineering improvements which appear possible are awaiting the development of better materials which will do the job. The types of improved materials that are needed are numerous, and practically every field of materials technology is involved. The requirements run all the way from improved fuels and lubricants to materials which possess very exacting physical and mechanical properties. In general, the most important requirements are for materials that will have improved properties at elevated temperatures.

If the necessary materials requirements can be met, there is promise that whole new areas of industrial activity and applications for metals will be developed. It is interesting to note, in this respect, that the theory and possibilities of a turbojet engine were suggested long before materials were available for the turbine components that would allow high enough operating temperatures for it to run at all. When the necessary high temperature alloys became available, development of turbojet and gas turbine engines was rapid, and the impact on our industrial activity was appreciable. Many of the new technological developments, such as the production of power from nuclear fusion, long range missiles, space ships, and more direct methods of winning metals from their ores may well be in the same period, timewise, as the turbojet engine was before materials became available which made it a success.

Research Programs and Progress

It follows then, that active research programs designed to develop new and improved materials and at the same time increase the basic knowledge of the properties of metals and alloys is extremely important to our technological progress at this time. As

we all know, a great deal of general information is known about the properties and behavior of the more common metals and alloys, most of it having been gained through years of practical experience. With this information and properly directed applied research and development programs, it has been possible to develop alloys which are particularly tailored to meet specific requirements such as high strength, high hardness, corrosion resistance in certain media, specific electrical and magnetic properties, and resistance to oxidation and deformation at elevated temperatures. But just as the engineer is finding it increasingly difficult to develop improved or radically new devices because of the limitations in the properties of the materials that are available to him, the research worker is finding it increasingly difficult to develop improved metals and alloys without a better understanding of the basic behavior of the metallic elements that he has to work with. It has been demonstrated, for instance, that tiny filaments or "whiskers" of pure iron can be produced in the laboratory which demonstrate a tensile strength of nearly 2,000,000 psi by actual test. No practical metals or alloys have been developed which have anywhere near this high strength. As yet, the reason for the high strength has not been satisfactorily explained, but the "whisker" tests are important because they indicate a natural limit to the strength of materials and show what we have to do to attain that limit. The effect that a structural material with a tensile strength of even 1,000,000 psi would have on our engineering developments would be difficult and exciting to comprehend. It follows that, to an ever increasing extent, future technological progress will depend on scientific advances rather than upon the availability and variety of natural products.

In order to obtain the basic scientific information that he needs, the research metallurgist finds himself working in a new environment. He recognizes that the help of physicists and physical chemists are needed to form a team which can get to the heart of his problems. Also, he is arming himself with new tools, such as high vacuum furnaces, spectrographs, and electron microscopes so that metals and alloys of high purity can be prepared and studied. Once the basic fundamentals of metal behavior are obtained and understood, there is reason to believe that many of the barriers that seem to exist today will be overcome.

General Fields of Metallurgical Research

From an applied point of view, metallurgical research today can be conveniently grouped into two general areas of activity. The first area involves the work that is being done to improve the properties of the more common metals and alloys. These metals, and their alloys, are iron, nickel, chromium, copper, cobalt, molybdenum, lead, tin, zinc, aluminum, and magnesium. All of these metals are available, commercially, in pure form and with the new vacuum melting techniques it is possible to study alloy behavior without the effect of the usual contaminants that mask the true behavior. New alloy combinations are being developed which have improved corrosion resistance, higher strength, greater toughness, and other special properties, that are needed for specific applications.

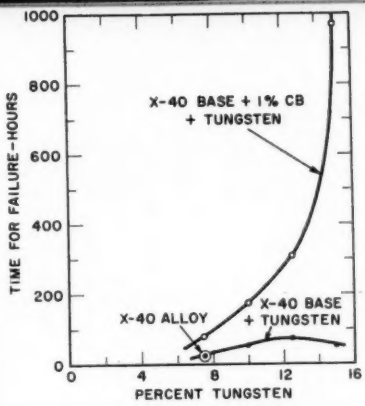


Fig. 1. Metal and alloy behavior at high temperatures is being studied in many research projects. Plotted here is the effect of increasing tungsten content on the rupture time of two cast cobalt-base alloys under a stress of 20,000 psi at 1600° F. Note how much a one percent addition of columbium increases the rupture life of the alloy

The second area involves the work that is being done with the less common metals and alloys. The metals and alloys in this group are titanium, zirconium, beryllium, thorium, columbium, tantalum, tungsten, rhenium, boron, yttrium, lithium, and the rare earth metals. Much of this work is aimed at developing the properties of these metals in pure form and studying their alloying characteristics. Enough has already been learned with many of these to indicate that they have some very promising military and commercial applications.

In general, the goals to be achieved in both areas of activity are quite similar and fall into four rather broad categories as follows: electrical and magnetic materials, corrosion resistant materials, high strength and high strength to weight ratio materials, and high temperature materials.

Electrical and magnetic materials: Under the broad category of improved electrical and magnetic materials, research is trying to solve many of nature's secrets about conduction and magnetism and considerable progress is being made. Research work on copper, which is strengthened by the dispersion of submicron size particles of a stable compound, such as aluminum oxide, indicates that it will be possible to develop a material that will be stronger at temperatures as high as 1000°F than type 304 stainless steel, with not less than 70 percent of the conductivity of pure copper. A material of this type has many applications for commutators and heat transfer devices which have to operate at temperatures above that at which copper or copper alloys can withstand. With magnetic materials, there is a need for stronger magnets which can operate at much higher temperatures. Research work on ferrites indicates considerable promise. In addition to magnets and materials, much research work is being directed to improve transistor, semi-conductor and rectifier materials. Ten years ago, semiconductors were little known materials of scientific interest only; today semiconductor products constitute one of the most rapidly growing industries. The development of solid state devices employing semiconductor materials, such as transistors and rectifiers, is adding a new dimension to electronics.

Corrosion resistant materials: From the standpoint of fundamental behavior, the knowledge and understanding of the controlling factors pertinent to the oxidation and corrosion of materials leaves much to be desired. Although a great deal of information has been gained from experiment and experience, it is still necessary to employ the trial and error method when materials are required to perform in new or more critical environments. Science is still unable to explain oxidation and corrosion except in the most vague terms. The best explanation is that refined metals and alloys tend to revert to their natural unrefined states when the reaction conditions are favorable. At the present time, the best that science can do is to determine the speed and degree of reaction of promising materials under various conditions and to devise ways of offsetting the effect.

There are many applications in the chemical and petroleum industries where materials of construction that will withstand corrosion, in both oxidizing and reducing media at higher temperature, are needed. Glass, platinum and tantalum are the best materials that we know about for many of these applications, but they have definite limitations. To find new materials that will meet the severe requirements, research is studying the characteristics of some of the more recently available metals, such as titanium, zirconium, and columbium. There is promise that alloys of these metals can be developed which will be satisfactory for many of the more severe requirements providing methods can be found to protect them from oxidation at the high temperatures.

TABLE I
COMPOSITION AND PROPERTIES OF WI-52 ALLOY

Composition		
Element	**Range (percent)**	**Aim (percent)**
Carbon	0.35/0.45	0.40
Manganese	0.50 max	Low
Silicon	0.30 max	Low
Chromium	19/21	20.0
Tungsten	10/12	11.0
Columbium	1.25/1.75	1.5
Nickel	3 max	Low
Iron	2 max	Low
Cobalt	Balance	Balance

Tensile Properties		
Room temperature tensile strength	105,000 to 110,000 psi	
Elongation in 2 in.	2.5 to 5.0 percent	
Temp. °F	**100-hour rupture strength**	**1000-hour rupture strength**
1600	24,000 psi	20,000 psi
1700	19,000	15,000

TABLE II
TENSILE PROPERTIES OF RECRYSTALLIZED REFRACTORY METALS
Short Time Tensile Strength (psi)

Temp. °F	Columbium	Molybdenum	Tantalum	Tungsten
Room Temp	50,000	68,000	50,000	80,000
1600	23,000	25,100	—	36,600
1800	18,000	—	—	36,500
2000	17,000	—	—	33,500
2200	14,800	18,000	9400	31,800
2732	—	—	—	10,700
3182	—	—	—	8250
3632	—	—	—	5800
4082	—	—	—	3400

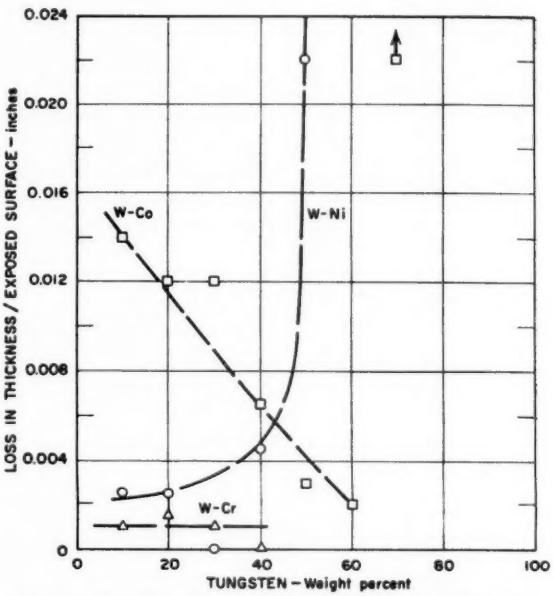


Fig. 2. Recent work to produce oxidation-resistant, high melting point alloys is beginning to show some interesting trends. For example, the loss of metal surface, during exposure for 20 hr in air at 2000° F. is plotted here as a function of tungsten content. Note the improvement of oxidation resistance when tungsten is added to cobalt

In heat transfer devices, such as atomic reactors and heat exchangers which employ liquid metals, such as lithium or sodium as the heat transfer medium, there is need for a container material which will not be corroded or dissolved by the liquid metal. This is a special form of corrosion. The temperatures involved may be as high as 1800°F, and it appears that the reactive metals and their alloys have considerable promise for these applications.

High strength materials: In the third category of materials requirements, much work is being done to develop high strength to weight ratio materials for missiles and supersonic aircraft structures. The main problem here is to find ways of maintaining toughness, ductility, and freedom from notch sensitivity at the high strength levels. The metal, beryllium, which is less than one-quarter the weight of iron, is being considered for structural components of supersonic planes and missiles. Titanium alloys, which have interesting strength to weight ratios at temperatures up to 1000°F are also being developed for structural components in military devices. High strength steels, with tensile strengths of 300,000 psi or higher are also being evaluated for many of the severe requirements. With all of these high strength metals and alloys, the problem for research is to determine the basic factors that influence ductility and notch toughness when high values of dynamic and static stresses are applied. It appears that the purity of the metals is an important factor.

High temperature materials: Of the four categories of materials research and development, it is quite probable that more effort is being directed toward understanding high temperature behavior than any other. Since the beginning of World War II, accelerated technology in many fields has been moving in the direction of higher and higher temperatures and there is every indication that this trend will continue. Of the many applications for new and improved high temperature materials, the power field appears to be the most dependent on new and improved materials for its progress. Whether we are converting heat from chemical combustion, nuclear fission, nuclear fusion or solar radiation to mechanical or propulsive energy, the efficiency of the conversion depends on the temperature at which the converter can be operated. Power plants for higher speed propulsion devices, and gas turbines are particularly dependent on higher temperatures for improved performance. The rate at which we can utilize the benefits of higher temperature operation will vary, directly, with the rate at which significant improvements in the properties of high temperature materials of construction and processes for fabricating them are forthcoming.

Today, all of the commerical high temperature alloys have either a nickel or a cobalt base or mixtures thereof. Several compositions are available which have satisfactory oxidation resistance and strength at temperatures up to 1700 or 1800°F. But at higher temperatures, the best of them begin to lose their strength rapidly. There are technical reasons to indicate that because of recrystallization and melting point limitations, we have about reached the maximum allowable temperatures for these types of compositions and that we must develop alloys based on the higher melting point metals if we are to make significant progress. One of the improved cobalt base alloys that was recently developed for the jet engine nozzle application is the WI-52 alloy. It is currently being specified for turbine nozzle vanes in advanced jet engines. During the course of a research program sponsored by The Tungsten Institute to find new uses for tungsten, it was discovered that increased amounts of tungsten in a cobalt base alloy did not increase the rupture life appreciably unless columbium was added to form a more stable carbide. As shown in figure 1, the X-40 alloy, which had been used for jet engine turbine vanes and blades since 1942, contained about ½ percent of carbon and 7½ percent of tungsten. With increased amounts of tungsten, up to 12½ percent, only a small improvement in rupture life was found. However, if one percent of columbium was also added to the alloy, a ten-fold increase in rupture life was found.

From this work, an optimum composition was worked out. The com-

(Continued on page 56)

An OPERATIONS RESEARCH APPROACH to Mine Haulage—Part II

By ERNEST KOENIGSBERG
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Touce, Niven, Bailey and Smart
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The second and final part of Dr. Koenigsberg's article deals with main line haulage, showing how operations research can aid in the understanding and solution of mining problems.

Main Line Haulage

The main line of a mine is, in a sense, the heart of the haulage and communications pattern. All sections funnel their output into it in much the same manner as manufacturers funnel shipments to the railroads. One can begin a discussion of haulage, therefore, by considering coal mining as a material transport and transfer industry rather than the more conventional view of the industry as one of raw material winning. The operational problems are then concerned with the ability to receive goods (coal at the face) and meet the delivery demands of the consignee (tipple). This analogy is not far-fetched and serves to concentrate attention on the haulage system itself.

Figure 5 is an illustration of mining operations from the perspective of the haulage system. The operation of a mine is considered as being composed of a number of cyclic operations; the work cycle of face operations, the shuttle car cycle for face haulage and the transport cycle of intermediate and main-line haulage. In this perspective, mining operations consist of transport cycles (the moving of coal) and transfer cycles, i.e., where coal is transferred from one haulage agent to another (as the loading point where shuttle cars transfer coal to mine cars or conveyors). Each transport and transfer stage can be characterized by a number of measurable parameters (i.e., number of units operating, time for the operation, the volume handled per operation, etc.). While the model is symbolic it contains most of the features of underground mine haulage systems.

Conveyor systems can also be represented in symbolic form and subjected to operations research analysis. Figure 6 is a block drawing of a conveyor haulage system in use at the DeKoven Mine of the Pittsburgh and Midway Coal Mining Co.[10] Here coal is transported by conveyor from the face to rock sorters to a raw coal storage dump and from there to the wash plant. A clean coal storage dump is also provided to insure the smooth flow of coal to railroad cars and barges even when parts of the system are down. This figure has been included to illustrate the use of storage or surge bins in a haulage system. It can be shown mathematically that such storage facilities increase the over-all efficiency of a system.[11] In fact, the gain in efficiency can often be expressed directly as a function of the storage provided.

These few models have been described to illustrate their use in helping to solve mine haulage problems of different kinds. What operators are concerned with is the cost of haulage systems (say, per ton of output) and the ability of the system to meet requirements in terms of some figure of merit such as the output of the mine (as well as safety requirements, delivery of supplies, etc.). An analysis, in terms of a model of the haulage operations, should be capable of predicting the output of the system (and the cost of its operation) as a function of the operating characteristics of the system. The analysis should also allow the evaluation of the effects of changes and modifications on the cost and output.

For purposes of illustration we can discuss the haulage system at Mine No. 9 of the Old Ben Coal Corp. (Data and figures supplied by O. D. McDaniel, Manager, Industrial Engineering, Old Ben Coal Corp.). Figure 7 is a schematic diagram of main line track haulage. There are seven operating sections, four coming in on the bottom and three on the top. Track is shared as shown in the diagram. The system operates with about 450 seven-ton mine cars and eight locomotives; one locomotive is assigned to each section and operates between the loading point and the

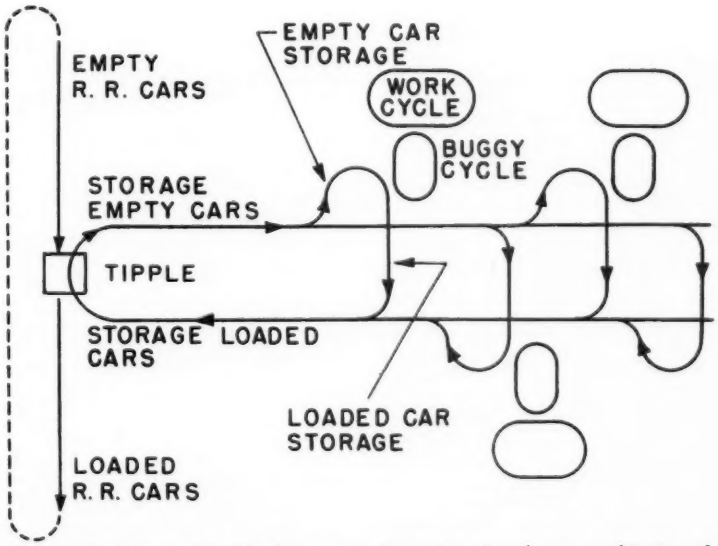


Fig. 5. Symbolic model of haulage system in a mine, viewed as a combination of cyclic patterns

marshalling area and another is in shuttle service between the marshalling area and the dump. There is sufficient track at the dump for about 150 mine cars and about 110 cars can be held in the marshalling area. Figure 8 is a symbolic model of the system showing the train loading time and the number of cars per train for each section. The travel times are also given. While the schematic layout does not include any interference that may be due to the sharing of track, the travel times include such effects.

The shuttle locomotive picks up 50 loaded cars which are dropped at the dump to be handled by a locomotive or cable hitch. It then returns to the marshalling area with a load of 50 empty cars which become available for any section. Because of the size of the system and complexity of the cycles (which are different for cars than for locomotives) this haulage system is more complex than the ones discussed previously. Thus far no analytic approach has been used in the study of systems of this size, more because operations research analysis has not been requested than because of the complexity of the problem.

It should be pointed out that there is a number of ways in which the system may function. For example, locomotives can be pooled rather than assigned: such operations may prove less costly in that fewer locomotives will be required. Locomotives may return to the section immediately after dropping their loads in the marshalling area or may be used for switching purposes before returning to the section with empty cars. Another alternative operation might be for locomotives to run on a schedule and pick up any available loads rather than wait for the loading of a full train. (The shuttle service can perhaps operate in the same way, picking up 50 cars or less if 50 loaded cars are not available.) The mine operator is interested in the "best" service where best can be interpreted as cheapest or maximum output or other similar criterion. Two operating systems have been investigated in a preliminary way using computer simulation techniques.

Rather than attempt an analytic model formulation, another approach has been used. When analytic methods prove too cumbersome, difficult or time-consuming, simulation of the system, i.e., setting up an analog of the system which can be manipulated by fairly straightforward arithmetic methods, can lead to a greater understanding of the problem and often provides a solution. The use of computers allows the time scale of the simulation to be compressed considerably; several months of operation can be simulated in a matter of hours.

The NCR 102A Computer at Midwest Research Institute was programmed to simulate the system in figure 8 (with several modifications). Operating assumptions are listed in the Appendix. The simulation was carried out by examining the state of the system at intervals of five minutes; cars are loaded, trains dispatched to and from the marshalling area, cars are dumped, empties become available for the return trip to the marshalling area, etc. Sample results for five days of operation are listed in Table V.

The simulation indicates that the seven section locomotives are more than adequate. In fact, for this five-day run, the system (in terms of the output rate of the sections) is operating at better than 100 percent efficiency. These results, obtained by using various distributions as input data, are more realistic than would have been obtained by the use of mean values alone. The latter would not account for interference between trains and would therefore have given only average outputs for all sections. The difference between the number of cars dumped and the number sent to the marshalling area is reflected in a congestion at the marshalling area. The simulation was carried out assuming that the marshalling area holds 150 cars. The delay incurred by the locomotives were nevertheless due

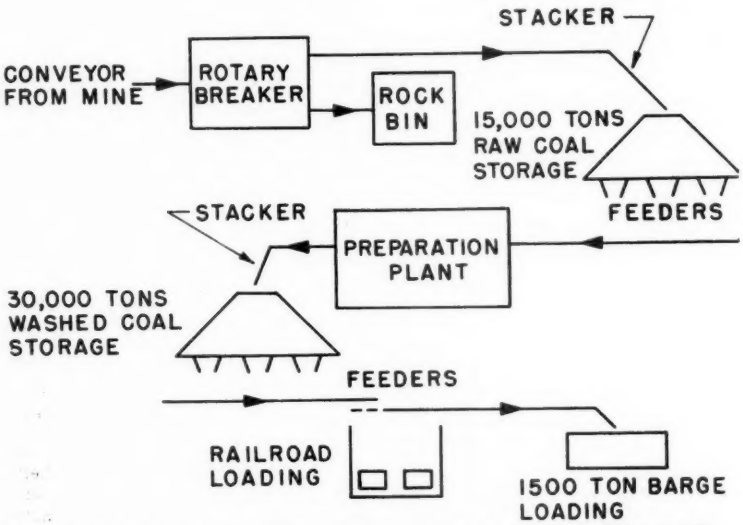


Fig. 6. Block drawing of a continuous conveyor system, based on DeKoven Mine of Pittsburgh & Midway Coal Mining Co. Storage allows each section to operate when other sections are down

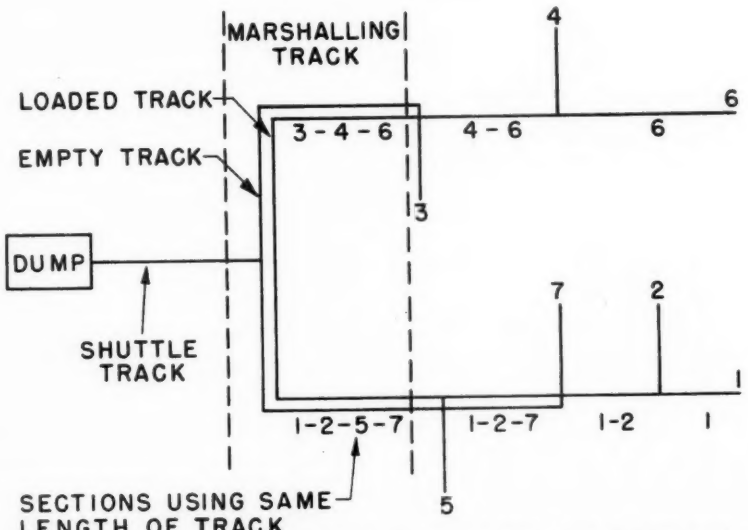


Fig. 7. Schematic diagram of main haulage system at Mine No. 9, Old Ben Coal Corp. Seven sections, each served by a locomotive, feed the marshalling area. A shuttle locomotive operates between the marshalling area and the dump

TRAVEL TIMES FOR SYSTEMS SHOWN IN FIGURE 8

Section	Travel Empty (min.)	Travel Loaded (min.)
1	18	19
2	15	16
3	8	9
4	9	11
5	12	12
6	8	9
7	11	12
Dump Shuttle	9	10

to inadequate storage track in the marshalling area (such blockages occurred in 29 out of the 450 intervals). The blockages, however, did not appear to cause any serious delays in loading, for full output was achieved by most sections.

To test the effect of a smaller marshalling area, a second simulation was carried out with the marshalling area reduced to space sufficient for 100 cars. Time available for computation did not allow the inclusion of all possible effects of marshalling area blockages in the simulation, but the results indicate that such blockages can be quite harmful. The marshalling area was fully loaded for 191 periods (of the total of 270 in a three-day sample) or about 71 percent of the time. The output of the dump was reduced to an average of 566 cars (instead of 603 cars in the previous example), a reduction of 6.5 percent. The output of the section was reduced to an average of 592 cars per day (instead of 635 in the previous example), a reduction of 5.8 percent.

This crude computer simulation suggests that fewer locomotives, operating on-call, might provide adequate service. Rather than attempt this by a trial and error method the computer could be reprogrammed for four, five and six locomotives in order to determine the optimum operating conditions. A more complete simulation analysis would probably indicate even more serious effects of marshalling area blockages than has been shown. More complete simulation studies will, no doubt, be carried out when detailed information becomes available.

It must be remembered that this example of the use of electronic computers as an aid to decision is, in a sense, rather crude. In practice, one would use distributions of loading, travel times and dump times which are based on actual practice. The

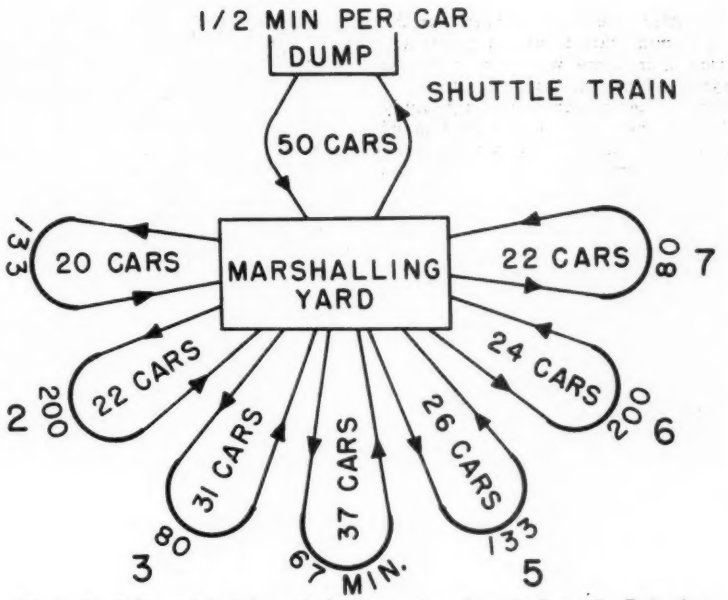


Fig. 8. Symbolic model of the main haulage system shown in figure 7. Train sizes and average loading time for a train are shown. Travel times are listed

TABLE V

RESULTS OF COMPUTER SIMULATION OF FIVE DAYS (SINGLE SHIFT) OPERATION

Section	Day 1	2	3	4	5	Avg.	Avg. Utilization
To Marsh. Yard							
1	150	100	100	125	100	115	1.02
2	50	75	50	75	50	60	1.07
3	75	100	100	100	75	90	0.80
4	150	125	100	125	125	125	1.11
5	125	125	75	100	125	110	0.98
6	50	75	50	50	75	60	1.07
7	25	75	100	75	100	75	0.665
Total (1-7)	625	675	575	650	650	635	100.5
Dumped	765	485	595	585	585	603	0.67

TABLE A-1

TRAIN CHARACTERISTICS FOR COMPUTER SIMULATION

Section	Train size (no. of cars)	Mean travel time one way (in min.)	Mean no. of cars loaded in 5 min.	Mean no. of cars loaded/day (90 5-min. intervals)
1	25	20	1.25	112.5
2	25	15	6.25	56.2
3	25	10	1.25	112.5
4	25	10	1.25	112.5
5	25	10	1.25	112.5
6	25	10	0.625	56.2
7	25	10	1.25	112.5
Dump shuttle	50	10	10*	900

*For dump shuttle mean number of cars dumped in five min. is listed in last column.

DISTRIBUTION OF LOADING AND DUMPING RATES

Loading (a) Mean value 0.625 cars/interval m*	Pm**	Loading (b) Mean value 1.25 cars/interval m*	Pm**	Dumping No. of cars in 5-min. interval	Probability
0	0.525	0	0.280	0	0
1	0.325	1	0.350	5	0.4
2	0.150	2	0.240	10	0.3
		3	0.100	15	0.2
		4	0.030	20	0.1

TABLE A-2
TRAVEL TIME DISTRIBUTION

m*	(a) 10 min. mean value Pm**	(b) 15 min. mean value Pm**	(c) 20 min. mean value Pm**
0	0.40	0	0
1	0.30	0	0
2	0.20	0.25	0
3	0 10	0.50	0.25
4		0.25	0.50
5			0.25

* m is number of five-min. intervals for one-way travel.
** P_m is probability that m intervals are required to complete the travel.

simulation would also account for the use of mine cars to haul supplies and account, in some way, for the track layout. This can only be done, of course, after a rather thorough study of the mine itself. (A more detailed simulation study, involving underground communications systems, has recently been reported—Clapham, J. C. R., *Oper. Res. Quart. 9*, 1; 1958). In many cases, the data are already available and only require analysis. The analysis (and/or the simulation) will produce results whose accuracy depends on the effort expended. The computer does not provide the answer to operating problems, it is a means by which solutions can be found.

Conclusions

Owing, to a great extent, to the paucity of material on this subject, this brief article only covers a small range of possible haulage problems and methods of solution. The pressing problems faced by mine operators and the importance of haulage to efficient operations will, it is hoped, encourage further operations research studies. The few examples cited do show that operations research can aid in the understanding and solution of mining problems.

The model approach and simulation are drawn from a larger group of methods and techniques (such as linear and dynamic programming, game theory, etc.) which are the "stock-in-trade" of the operations research analyst. While the analyst may deal with abstract mathematics, the numbers he manipulates have not arisen in a vacuum; they represent the essentials of very real problems of industry.

ACKNOWLEDGMENTS

The author would like to thank Messrs. P. C. Constant and J. Wimp of Midwest Research Institute for programming, coding and carrying out the haulage simulation on the NCR 102A Computer. Thanks are also accorded to the many people in the mining industry who have contributed to my education in mining.

BIBLIOGRAPHY

[1] E. Koenigsberg and S. R. Neuberger, *Mining Congress Journal*, p. 64, March, 1958.

[2] Cook, S. L., Proceedings of Conference on What is Operations Research Accomplishing in Industry, Case Inst. of Technology, pp. 31-43, (1955).

[3] Cook, S. L. and Evans, T. A., *Iron and Coal Trades Review* (London), *162*, 787, 853 (1951).

[4] Evans, T. A., *Transactions*, Institution of Mining Engineers, *110*, 405, (1951).

[5] Clapham, J. C. R., Paper read before Manchester Geological and Mining Society, April 11, 1957.

[6] Clapham, J. C. R., *Operational Research Quarterly 8*, 181, (1957).

[7] Solomon, M., Paper presented at 5th Annual Meeting of the Operations Research Society of America, Philadelphia, May 10, 1957.

[8] Krikovic, S., *Mining Engineering*, *9*, 1345, 1957.

[9] Koenigsberg, E., *Operational Research Quarterly*, 922, 1958.

[10] Quirly, C. S., *Mining Congress Journal*, *43*, 32 (1957).

[11] Koenigsberg, E., to be published.

APPENDIX

The computer simulation was based on the main line haulage system shown in Fig. 8, modified in order to allow some simplifications in the computer program. Since exact data on the distribution of loading, dumping and travel times were not available, an exact solution would not be possible in any case. The modifications do not affect the model insofar as illustrative purposes are concerned.

It was assumed that each section sends trains of 25 loaded cars to the marshalling area and that locomotives return with 25 empty cars. The travel time is the same for both empty and loaded car trains from a given section. The characteristics of the sections are listed in Table A-1. The distributions associated with each characteristic value are given in Table A-2.

The following limitations were assumed:

a. The dump holds 150 cars (empty and full).
b. The marshalling yard holds 150 cars (empty and full).
c. Each section holds 50 cars (empty and full).

The computer program examined the state of the system at five minute intervals. By generating random numbers, the loading and dumping rates and travel times were determined for all activity in the interval. The movements were recorded and stored for future examination in the program. The occupancy of the dump and the marshalling area were preserved to obtain their distributions; the total number of cars moved to the marshalling area and the number dumped were also accumulated to obtain a measure of the output of the system.

NEW USES FOR MINERAL PRODUCTS

(*Continued from page* 52)

position and properties of the WI-52 alloy, are shown in table I. For the same load, the alloy will withstand about 100°F more than the X-40 alloy which was previously used for the same application. This work is being continued to develop higher tungsten content and tungsten base alloys for higher temperature applications. The biggest problem appears to be one of finding alloy systems which have improved oxidation resistance at the higher temperature.

Recent work designed to develop oxidation-resistant, high melting point alloys is beginning to indicate some interesting trends. Oxidation tests with nickel-tungsten alloys have shown that up to 20 percent of tungsten can be added to nickel without seriously detracting from the oxidation resistance at 2000°F. On the other hand, when up to 60 percent of tungsten is added to cobalt, the oxidation resistance is improved. The weight loss data shown in figure 2 indicates the magnitude of the improvement. Work on other binary tungsten alloy systems and on ternary alloys is in progress and there is every indication that some very worthwhile compositions will be forthcoming.

We have known for some time that the limiting temperature at which a pure metal will still have useful load carrying ability has a definite relationship to the melting point of the metal. Of the seventeen metallic elements with melting points higher than those of nickel, cobalt, iron and chromium, it is apparent that the four commercially available refractory metals —columbium, molybdenum, tantalum, and tungsten—are the ones that we must develop if we are to achieve our goals. A tabulation of the available tensile properties at various temperatures, for these four metals is shown in table II. Even though only two tests are available for tantalum, it would appear that it is the weakest metal of the four and that tungsten is the strongest, with molybdenum and columbium in between.

The most serious problem with these refractory metals is to find methods of protecting them from oxidation at the high temperatures. In an effort to solve this problem, research work is being directed towards obtaining a better understanding of the basic factors which control surface reactions between the metal or alloy and its environment. Both the binding energies of the alloying elements and the physical properties of the reaction products at the surface are being studied. There is promise that some of the electropositive rare earth metals, such as yttrium, lanthanum and cerium, that have stable, adherent, high melting point oxides will be important in improving the oxidation resistance of the high melting point metals and high temperature alloys.

In developing the high melting refractory metals and alloys, it goes without saying that there are many other problems to solve before they can have commercial value. The alloys must be ductile, and methods will have to be developed to work them into the desired shapes. Once it is demonstrated however, that alloys can be made which have the desired engineering properties at temperatures above 2000°F, the remaining problems will be solved in short order.

Future Progress Unlimited

In summary, it seems clear that we are now in a period in which the success of important, new technological developments depend on our ability to develop improved materials that will meet the ever increasing requirements. This is particularly true in the high temperature field. It goes without saying that the only hope we have of developing the improved materials is through continued research. If we are successful, there is reason to believe that engineering progress in the next ten years will exceed everything that has been done in the last century. And the use of metals and minerals will increase accordingly.

The reports were listened to by an attentive audience

COAL DIVISION CONFERENCE

Large Attendance Reflects Bright Outlook

THE Penn-Sheraton Hotel in Pittsburgh, Pa., was the scene of the 24th AMC Coal Division Annual Conference on November 14, 1958. Representatives of coal producing companies and manufacturers of mining equipment crowded the meeting rooms to hear and discuss the technical problems currently occupying the attention of the Coal Industry.

Eighteen subcommittees of the seven Coal Division committees reported on activities during the year. The Committees on Coal Preparation, Mine Safety, Mechanical Mining and Strip Mining reported at the morning session. During the afternoon the Committees on Underground Power, Mine Haulage and Roof Action told of their work.

At a luncheon meeting, also filled to capacity, Jack H. How, President of Western Machinery Company and Chairman of the AMC Manufacturers Division, presided. Featured speaker at the luncheon was Eugene Gordon, Vice President, West Penn Power Co., whose address was titled "Coal and the Electric Power Industry." His remarks appear on page 25 of this issue.

The only requirement for membership on the various Coal Division Committees is an interest in coal mining. All committee work is planned with the original object of the Division in mind—to present the facts concerning modern mining methods to the industry without recommendations or bias. Individual committee meetings are held twice a year, with further subcommittee meetings arranged as needed, to assemble and review information that is constantly being gathered. As studies are completed they are made public to the industry through publication in MINING CONGRESS JOURNAL.

Following is an account of the reports as they were presented:

COMMITTEE ON COAL PREPARATION

R. L. LLEWELLYN, Chairman

THE first report of the day was given by J. J. Reilly, chairman of the subcommittee on "Washery Water Clarification." The subcommittee has generally agreed that basically there are two phases which are closely related to the water clarification problem: (1) solids control, which gives the operator what he wants, and (2) maximum recovery, which depends on what the operator can sell. Most operators agree that with clear water a preparation plant can process more tonnage, produce a better and more uniform product, and reduce maintenance.

To accomplish solids control, the plant operator must establish the plant build-up size and the necessary plant bleed. The amount of fines that must be removed in order to balance the system must be determined, and the means of disposal established. When the build-up sizes stay in suspension a flocculent must be used. In this case the operator, if possible, should only floc the build-up size because the more solids that settle, the higher the cost.

* * *

Ed Mills reported on a heavy medium recovery symposium that the Coal Preparation Committee held September 10 at Evansville, Ind. Those participating in the discussion were Fuel Process Co., Link-Belt Co., McNally - Pittsburgh Manufacturing Corp., Nelson L. Davis Co., Roberts & Shaefer Co., Western Machinery Co. and Wilmot Engineering. Each of the manufacturers briefly described his heavy medium coal washers and his medium recovery system.

It was pointed out that an efficient recovery system begins with dry and prewet screening prior to introducing the feed coal to the washer. Purging the fines from the feed will result in less contamination of the medium. This in turn, will promote fewer vis-

cosity problems within the bath and minimize the build up of nonmagnetics.

Mills also commented on the fact that the current trend in magnetite recovery is the use of the drum-type separator.

Media gravity controls vary in nature from dip tubes to electronic-type media. In some instances these controls are merely indicators of gravity, requiring a manual duty for adding either magnetite or water. In other instances, these controls are indicators and automatic controllers. Whichever control scheme is employed, it was unanimously agreed that a medium gravity accuracy of 0.01 was easily maintained.

In spite of all the magnetite reclaiming equipment that is available and is installed, one manufacturer pointed out that the proper size of drain and rinse screens for the involved tonnages, and the location of the sprays on the screens, can do the most to minimize magnetite losses.

* * *

The next report, presented by Jack Bishop, had to do with "Coal Analysis Procedures." Realizing the ASTM standards for determining the moisture, ash and sulphur contents of a coal sample were too long for practical application at many coal preparation plants, this subcommittee has undertaken the job of determining shorter standard procedures that will be acceptable to ASTM and the coal industry.

The subcommittee believes that: (1) The entire problem should be looked upon as individual plant problems, (2) current practices among various companies should be evaluated, (3) no standard procedure should be devised for all coal in the various locals, (4) any evaluated accepted procedure should have an accuracy equal to or approaching present ASTM requirements, and (5) any accepted procedures are to supplement rather than supplant ASTM procedures.

The final report of the Committee on Coal Preparation had to do with "Preparation Plant Start-Up Problems." R. L. Llewellyn made the presentation. Manufacturers and coal companies alike have agreed to cooperate by submitting a list of common start-up problems that each has experienced. The subcommittee will then classify and tabulate them. It is hoped that a great many of these problems can be eliminated.

Some of the more common start-up problems already submitted to the subcommittee could have been avoided by: (1) training operating personnel in the start-up of a plant, (2) closer cooperation between the manufacturer and the coal company in composing the flowsheet and establishing capacities, and (3) allowing ample time to install the job.

COMMITTEE ON MINE SAFETY

RALPH KIRK, Chairman

BELIEVING that there was one area of safety which was not being cultivated by any of the other agencies in the safety field, the Committee on Mine Safety was organized to provide a channel for the orderly submission of opinions from both mine operators and equipment manufacturers. The first activity of this newly formed committee was a study on shuttle car design improvements which would lead to increased safety for the shuttle car operator.

Ewalt Herzog discussed the project. The committee has boiled down the many suggestions considered to a total of six. The first is increased operator comfort and protection. While there has been steady progress in design improvement to protect the lower regions of shuttle car operators, it is felt that more can be done to protect the head and shoulder areas against roof and timber falls and crushing. Use of shuttle cars in pitching seams poses protection problems because of possible skidding on wet bottoms and the need to protect the operator against hanging over the side of the car when he is on the down-dip side of the car traveling along the strike.

Other suggestions included improved signaling devices, better traveling lights, and the use of some device that would give an audible signal when the shuttle car approaches a rib. The committee also feels that more attention should be given to design and placement of switch and button controls so that they can be easily operated and not be hazardous to the operator. Final suggestion was in regard to protection against the whipping of trailing cables. Accidents have occurred as shuttle cars start to back up and slack is suddenly taken out of the cable.

* * *

C. G. Evans reported on a meeting the committee held last September at which Dr. Irving Hartman and George Alston discussed mine fires and preventing mine fires. Dr. Hartman described the U. S. Bureau of Mines experimental work on the English method of using a traveling foam plug to put out mine fires. He said that the foam plug can move long distances and around corners, reduce the total quantity of air reaching the fire and, through vaporization, provide a cooling effect. In addition, the water vaporizes and reduces the oxygen content.

Dr. Hartman also brought the group up-to-date on studies by the Bureau with respect to agglomerating dust on the ribs and floor, float dust and effectiveness of wet rock dusting. He stated, on the basis of his experiments at the experimental mine, that seven gal of water per 100 lb of rock dust made the best solution for wet rock dusting. Experiments also showed that 0.6 lb of rock dust per sq ft would stop the propagation of an explosion. He believed that wet rock dusting should be confined only to the face region, for the reason that wet rock dusting is not quite as effective in stopping an explosion as dry rock dusting. It was also pointed out that more research should be done regarding limestone as there is a wide variation in effectiveness of rock dusting depending upon the chemical structure of limestone.

George Alston described the use of foam in conjunction with continuous mining machines to cut down the dust content in the air. In addition he outlined some of the advantages and limitations of sodium bicarbonate and other chemicals for fighting underground fires.

COMMITTEE ON MECHANICAL MINING

WILLIAM E. HESS, Chairman

THE first group of the Committee on Mechanical Mining to report was the subcommittee on "Continuous Mining Systems." The report was presented by Paul Paulick. To determine what system might be used in continuous mining, this subcommittee is making a study of the various coal mining systems employed by companies who have gone into continuous mining. Paulick discussed a large continuous mining operation, describing the type of roof, cover, type of equipment used and other factors influencing the selection of the mining system.

* * *

Steve Szekely reported on "Remote Control of Mining Equipment." He described work that the mining development committee of Bituminous Coal Research, Inc., and Stromberg-Carlson are doing in developing a unit for remote control of mining equipment. They have at the present time completed and field tested two of the three parts of the system—a sensing device and servo controls. The other system which they are working on is the computer section which takes information from the sensing device, computes it and feeds instructions to the servo controls. The complete package is expected to be ready within a year. There has been quite a bit of thinking relative to the remote control of continuous mining machines and the future looks bright.

* * *

The report of the subcommittee on "Dust Control for Continuous Mining," was presented by J. A. Younkins, chairman, assisted by Ward Stahl,

Don Kingery and George Alston. Ward Stahl and Don Kingery described work that the Bureau of Mines has been doing in experimentation with auxiliary ventilation equipment. Stahl reported on tests conducted at one mine, telling how an exhaust fan with tubing did not offer a complete solution to the ventilation problem because it is difficult to keep the end of the tubing close enough to the face to get circulation around the head of the continuous mining machine. The addition of a small 1000 cfm hydraulically operated fan attached to the machine, in conjunction with the exhaust fan, did provide a solution. In order to operate continuous mining machines efficiently, he stressed, companies have got to resort to something else other than line brattice.

Don Kingery provided some additional information on the application of auxiliary ventilation underground. He stated that the auxiliary fan should only handle 40 percent of the air that is available at the last open crosscut. This is one Bureau of Mines' requirement that will probably have to be met in any auxiliary system, he added.

Alston reviewed another interesting development during the past year—the possible application of foam as a dust suppressor at the face. He said that the idea is to apply the foam at the bits of the continuous mining machines in such a manner that the bits are cutting in the presence of foam instead of in the presence of air. So far the work has been strictly experimental.

COMMITTEE ON STRIP MINING

E. R. PHELPS, Chairman

FIRST report of this committee was given by John Jeffries on "Ammonium Nitrate Blasting." At a meeting the committee held last September, a panel composed of users and manufacturers of explosives discussed the most recent advances in ammonium nitrate blasting. The panel consisted of James Reilly, Don McCloud and John Jeffries.

James Reilly described his company's system of blasting involving prilled ammonium nitrate of proper specification coated with an anti-caking agent, two different mixtures of oil and 60-grain Primacord. It was found desirable to use prills coated with 0.4 percent of diatomaceous earth, instead of the usual two to three percent which is normally used by fertilizer manufacturers. The material is mixed with oil on a weight ratio of six percent for the main charge, and two percent for the primer cartridge.

Don McCloud compared ammonium nitrate-oil mixtures with liquid oxygen explosives. He emphasized that the over-all picture must be considered in choosing a blasting system, not just the cost of explosive itself. In certain instances a high velocity explosion is needed, and in other places the much lower velocity of ammonium nitrate-oil mixtures.

In reviewing his own paper, John Jeffries briefly summarized the history of ammonium nitrate as an explosive, going back to 1867 when a patent was issued in Sweden for the use of ammonium nitrate in explosives. In discussing experiments with this explosive in blasting wet holes, he cautioned that conditions must be satisfied: (1) There has to be good confinement, (2) the detonation should be initiated with a continuous core of high velocity, high strength and high density gelatin, and (3) enough ammonium nitrate must be present to form a sludge or slurry.

Jeffries also told about the development of a machine to blow-load horizontal holes.

In discussing detonating cord, Jeffries pointed out that a subcommittee had been appointed to investigate the subject of detonating cords, with emphasis on the safety angle.

* * *

Final report of the morning was presented by Al Meger, who summarized a panel discussion on "Wire Rope Maintenance" that was held by the committee last September. The panel was composed of F. Chiappetta, H. E. Nicholson and Al Meger.

Meger pointed out some of the important points brought out by the panel such as: eliminating any interference that will damage external wires by rubbing or cutting, use of alloys in sheave wheels to eliminate casting troubles and checking the machine to determine how it can best be used at maximum power with a minimum of overloading. He cautioned that rope fittings must be of the proper design and kept in repair. Broken wires should be clipped as they occur because other wires can be nicked by the broken ones and damage can spread rapidly. One of the cheapest and best of all maintenance pointers for wire ropes, he said, is adequate lubrication. It is important to teach operating personnel how to inspect ropes, what to look for and what to expect. Other points that Al Meger discussed included keeping good records, making daily inspections and establshing yardage standards.

In summing up the panel's discussion, Meger said that just about any problem can be solved if adequate qualified personnel can be assigned to investigate, recommend, design the new or change the old. Operators must develop initiative, spend time and money in improving their equipment. Cooperative efforts of qualified men representing manufacturers and operators have and will continue to produce results, and wire rope is a wonderful place to save money.

Highlight of the luncheon was an address by Eugene Gordon, vice president, West Penn Power Co.

COMMITTEE ON UNDERGROUND POWER

JOHN A. DUNN, Chairman

FOLLOWING lunch the Committee on Underground Power made its report to the Annual Coal Division conference. The first subcommittee to discuss its work was the one on "Characteristics of A-C Mining Machinery."

Commenting on the reasons for the report, Frank Hugus stated that the switch to a-c powered machinery is coming rather fast in the coal mining industry and that the success of this transition depends upon the ability of maintenance men to understand a-c machines and keep them in operation. The report, which was published in two parts in the July and August issues of MINING CONGRESS JOURNAL, is aimed at the mine electrical engineer who has had d-c experience and is exploring a change to a-c power underground.

* * *

Progress in the work of the subcommittee on "Temporary Cable Splices," was covered by E. G. Sturdevant. Dr. Sturdevant reported that the first part of a three-part study had been completed and a report published. The report consisted of an evaluation of the performance characteristics of temporary splices as they were applied by mine operators in trailing cables.

The second part of the study consists of an investigation of improved materials for making splices. The subcommittee has taken the problem up with connector manufacturers who have been asked to submit splices made under factory conditions and to develop a splice which was felt would give better service. Sample splices have been received from three manufacturers and are now under test. As soon as results are available, they will be made known to the industry.

* * *

Progress of the work of the subcommittee on "Cable and Cable Accessories for A-C Mining" was recounted by Mike Kopchik. The first step of this subcommittee was to decide that the report should be prepared in two sections: one on cables rated at 600 volts; the second for high voltage cables, those rated above 600 volts. Each part of the report will contain information on the selection of the availability of present day cables, methods of installation, terminations, temporary and permanent splices, and testing and maintenance of cables. The subcommittee has started to accumulate information on capacities, resistance, reactance, and voltage drop in various cables that are presently available.

* * *

Chester Conrad presented the final report of the subcommittee on "Engineering Underground Power Systems." Conrad said that the greatest problem to be encountered in the installation of a-c underground in coal mines will be the matter of voltage regulation. The report contains information on the selection of conductor size, conductor configuration, and proper voltage. The report will be published in an early issue of MINING CONGRESS JOURNAL.

The report of the committee on Underground Power was concluded with a discussion by Frank Hugus of the need to disseminate information on the use, care and maintenance of trailing cables. John Dunn stated that the Committee on Underground Power plans to solicit information along these lines and issue a report sometime in the future with the ultimate aim of improving cable life.

COMMITTEE ON MINE HAULAGE

A. G. GOSSARD, Chairman

C. D. REESE presented a report on "Conveyor Load Regulation." As the installation of belt conveyors in the Coal Mining Industry continues to grow and additional mines begin to integrate several conveyors into a single haulage system, the subject of load regulation takes on greater importance. The ultimate in any well-planned conveyor system is to provide a continuous flow of coal from the working sections to the discharge point and load regulation plays a big part in the success of such a system.

Load regulation for a series of belt conveyors will continue to require good engineering analysis of both current capacity as well as future tonnage requirements. Progressive changes of belt width and belt speed will remain the initial solutions to load regulation in all heights of coal seams, however, other methods to supplement these will be varied to match the mining conditions, the tons of coal to be conveyed and the rate of production to be obtained from each panel conveyor.

There is as great a need for a feeder between the shuttle car and the conveyor in low coal as in high coal, however, space limitation and mobility features have limited the success of feeders in low coal to date. The load regulation from shuttle cars to belt conveyors in these seam heights almost demands a feeder device, if the maximum efficiency of a shuttle car is to be obtained and the belt conveyor is to receive the optimum in care and maintenance.

Load regulation from a shuttle car to a single belt conveyor has been solved readily by adjusting the combination of belt width and belt speed to match shuttle car discharge rate; except in low coal where limited height increases the problem since hoppers and load stations must remain shallow.

* * *

The report by the subcommittee studying "Future Demands on Mine Haulage Systems" was presented by C. S. Szekely. He pointed out that in the present stage of the art of mining, production peaks in high coal are reaching 1800 tons per unit shift and some units are averaging 1200 tons per shift. The subcommittee believes that in the not too distant future, production might average as high as 2000 tons per unit shift in high coal. When these production rates are reached, a tremendous burden will be placed on mine haulage systems, not only in handling this production, but also in handling supplies to the face. Before an effective means of answering the demands on haulage can be devised, the parameters of the problems need to be defined. This subcommittee anticipates determining just what demands will be placed on mine haulage systems in the near future as the first steps towards the development of constructive methods of handling mine supplies in high production mines.

COMMITTEE ON ROOF ACTION

J. ALLAN BROOKES, Chairman

Final committee to make its report to the Coal Division conference was the Committee on Roof Action. Ed Carroll reported that a subcommittee on "Size Coding Drill Bits" had learned from bit manufacturers that bits can be marked in such a way as to indicate their size, but that the effectiveness of such a program rests in the lap of mine operators, since these marks have to be altered whenever a drill bit is ground to a smaller size. He also reported that manufacturers of drill bits would not go further into the establishment of a standard marking unless the industry expressed more desire than it has up to this point on the project.

* * *

M. H. Kettering reported on the progress of the subcommittee on "Standardized Roof Bolt Pull Testing Procedures." After pointing out that the subcommittee was organized, in effect, to learn something about roof control, he pointed out the various reasons why it is advisable to establish a uniform method of pull testing. Even more important is the need to arrive at an agreement of what the results of such pull tests means in terms of anchorage strength.

In a step in this direction, two manufacturers of roof bolts and the U. S. Bureau of Mines conducted simultaneous pull tests, using their own individual procedures, at a mine in northern West Virginia in October. These tests will be evaluated in the light of their effect on the final interpretation of results and will serve as a basis for the establishment of a suggested procedure of anchorage testing.

Operators' Corner

Safety Glasses SAVE EYES

By J. M. WHITING

THE benefits resulting from a "safe practice" can rarely be itemized or proved. Accidents which do *not* happen, thanks to diligent efforts by the safety department and employees, are usually impossible to tally up.

Once in a while, fortunately, facts and figures do accumulate which point conclusively to the value of a particular safety program. These somewhat isolated examples should be especially heartening to safety personnel, because they demonstrate the importance of safety work to everyone in the industry—and do it more effectively than a million words on the subject.

MINING CONGRESS JOURNAL would like to spotlight one typical safety program that has paid off in handsome—and obvious—rewards.

On January 1, 1954, *all* men working underground at Homestake Mining Co. in Lead, S. D., were *required* to wear safety goggles throughout the entire work day. On January 1 of the following year, this rule was extended to include all surface departments too (except office workers).

The results of the Safety Goggle Program at Homestake are striking.

The first year this program was in effect—1954—there was a total of three lost-time eye injuries, without a single eye disability. The average number of lost-time eye injuries in the Mine Department for the previous six years was 19 per year, with a total of 11 eye disabilities—five of which were for total loss of one eye. (See graph.)

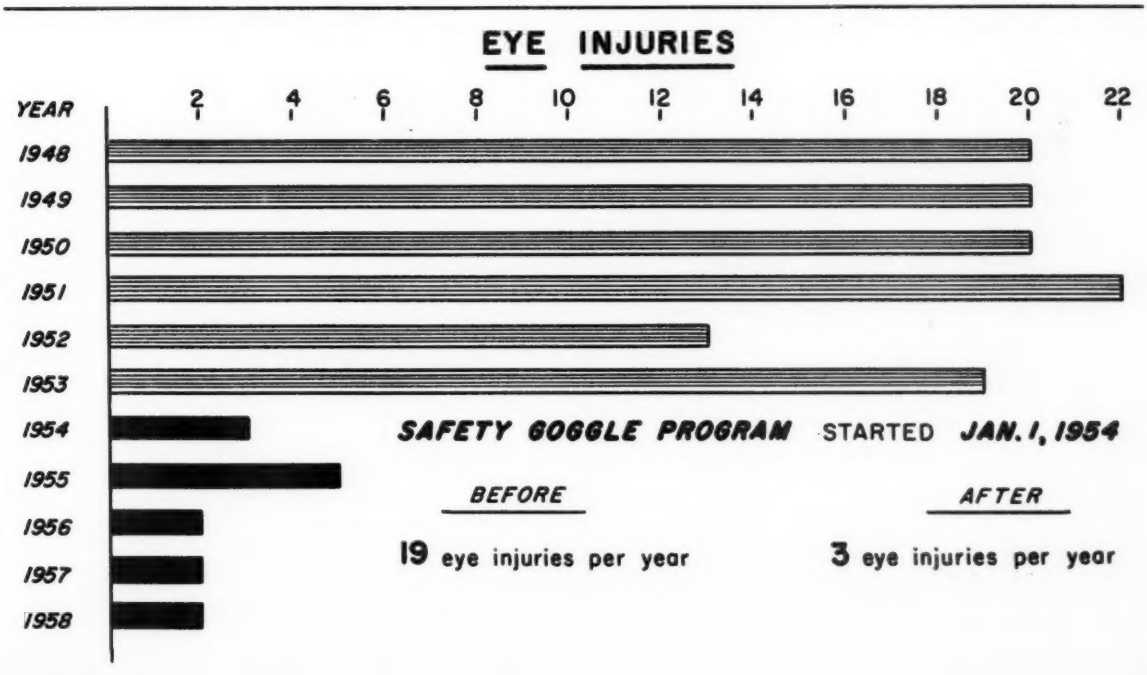
Today, after the program has been in operation almost five years, the drastic drop in the yearly average of eye injuries is even more meaningful. The average, since January 1, 1954, is less than three eye injuries per year, with not even one partial disability!

Eye injuries are not restricted to the mining industry. The National Society for the Prevention of Blindness estimates that eye injuries resulting from accidents at home, work, or play occur at the rate of 1000 per day. Approximately 300,000 eye injuries were sustained by industrial workers last year. The tragic part of these statistics is that an estimated 90 percent of them could have been prevented if proper eye-safety equipment had been worn. Homestake's records tend to prove the validity of this estimate.

Eye care is good economy too, because the national average compensation award for the loss of an eye is about $4,000. There are over 15,000 employees in the United States at the present time who almost certainly have had an eye saved by use of saftey glasses. These people represent a savings to industry of over $60,000,000.

The value of wearing safety glasses throughout the entire work day has been proved at many mines and plants, just the same as it has been proved at Homestake. Until an infallible crystal ball is perfected which will predict when and where an eye accident will occur, 100 percent use of safety eyewear will continue to be the best way to reduce needless eye injuries and the human suffering and financial waste that go with them. Homestake Mining Co. and other companies which have realized this fact, and have taken action to reduce eye injuries, are to be complimented on their fine safety program.

Half of all blindness is needless and preventable. Safety departments and individuals who are interested in information which can help prevent the loss of sight can write to: **National Society for the Prevention of Blindness, Box 426, New York 19, N. Y.**



As Viewed by HARRY L. MOFFETT of the American Mining Congress

★ ★ ★ ★ ★ ★ ★

Washington Highlights

CONGRESS: Convenes January 7

COAL WAGE AGREEMENT: Regular and vacation pay boosted

LEAD-ZINC QUOTAS: To remain in effect

OIL IMPORT CONTROLS: Mandatory or voluntary?

URANIUM PURCHASE PROGRAM: Guarantee revised

GAS PIPELINES: Expansion predicted

MINERAL PURCHASE PROGRAMS: Terminated

TARIFF COMMISSION: Completes mercury study

BLM: New Denver manager

★ ★ ★ ★ ★ ★ ★

THE First Session of the 86th Congress, most lopsidedly Democratic since the heyday of the New Deal more than two decades ago, is due to get under way with swearing-in ceremonies January 7. First major item of business confronting the lawmakers is the Federal budget for the fiscal year 1960, which begins next July 1.

It now seems clear that there is little chance for any tax reduction this year. Chairman Wilbur Mills (Dem., Ark.) of the House Ways and Means Committee, which handles all tax legislation, has indicated that any such cuts are precluded by the tight budgetary situation. On the other hand, he said, the tax structure must be revised so that it can "withstand the siege of high revenue requirements so long as they remain a possibility" and to avoid inflation.

Mills pointed out that a great deal of revenue could be provided by a broadening of the tax base, including "a removal of some special deductions and preferences and an increase in rates on some specially favored income." He added that some of the long-range results of eliminating or tightening up so-called loopholes would probably be the easing of extra-high taxes in the top income brackets and more liberal treatment of plant and equipment depreciation.

COAL WAGE SCALE HIKED

Most of the Nation's coal mine operators, represented by the Bituminous Coal Operators Association and the Southern Coal Producers Association, have signed agreements with the United Mine Workers of America providing a wage increase of $1.20 a day for miners, effective January 1, and an additional 80 cents a day, effective April 1. In addition to hiking the basic daily wage to $24.25, the agreements also boost annual vacation pay to $200 from $180.

The agreements cover an indefinite period and are not subject to termination prior to November 30, 1959. After that date they may be terminated by either the operators or the union provided that at least 60 days' written notice has been given to the other party.

A "Protective Wage Clause," which was not a part of the separate agreement covering "captive" mines, was included in the agreement covering commercial operators. This clause, aimed at nonunion coal mining operations, requires that all coal mined, produced, or prepared by commercial operators, or procured or acquired by them under a subcontract arrangement, "shall be or shall have been mined or produced under terms and conditions which are as favorable to the employees as those provided for in this contract."

BCOA said it agreed to the Protective Wage Clause "under extreme union pressure" and only to avoid an interruption of supply to coal customers, who "have come to expect this continuous supply without the necessity for uneconomic stockpiling." There have been some reports published which indicate that a court test may be sought as to the legality of this provision.

GOVERNMENT OFFICIAL AIRS LEAD-ZINC VIEWS

A U. S. Government official who has played a part in the recent international discussions of world lead-zinc overproduction problems indicated in a recent speech that United States quotas on imports of lead and zinc, which became effective October 1, 1958, will probably remain in effect for at least a year.

Clarence W. Nichols, deputy director of the State Department's Office of International Resources, who spoke informally and unofficially at a meeting of the National Association of Waste Material Dealers, also said that a third meeting of about 20 lead and zinc producing and consuming nations may be held early in March in New York, under United Nations auspices, to discuss further the problem of excess world production and price stabilization of these metals.

Nichols declared that there is not much chance that the forthcoming meeting would be any more successful in getting other lead and zinc producing nations to agree on production and export controls than earlier meetings in London and Geneva, but added that he expected a subcommittee to be named to make a detailed study.

Among the roadblocks to any such international agreement, he said, is the lack of adequate statistics on world consumption, production and trade in these metals. Nichols concluded that there is only a 50-50 chance that eventually an agreement would be reached.

MANDATORY OIL IMPORT CONTROLS?

As this is written, unofficial reports indicate that the Cabinet Committee studying proposals to revise the voluntary oil import limitation program has decided to recommend that mandatory controls be placed over imports of crude petroleum and products—except residual oil. While such action would prove helpful to the domestic oil industry it would not aid the coal industry in overcoming the problem of depressed markets caused by excessive residual oil imports.

The Cabinet Committee's recommendations have to be sent to the President, who may adopt them or continue the voluntary import restriction program on a revised basis. It has been hinted that, should the President decide to take the latter course, the Cabinet Committee would recommend that 60 percent of the total quotas be allocated on the basis of historical import patterns, with the remaining 40 percent allocated on the basis of refinery activity.

AEC REVISES URANIUM PURCHASE GUARANTEE

The Atomic Energy Commission has announced a revision of its 1962-1966 Domestic Uranium Concentrate Purchase Program which, in effect, puts the uranium mining industry on notice that the Government will not guarantee to buy concentrates milled from ore discovered or developed after November 21, 1958.

In May, 1956, the AEC announced that it would guarantee the purchase of uranium oxide at $8 per pound in acceptable concentrates produced and delivered during the period April 1, 1962-December 31, 1966. Under the revised program, this commitment will be carried out only with respect to reserves developed prior to November 21.

Paul F. Foster, AEC general manager, said the effect of this modification will be "to provide the domestic uranium industry with a substantial continuing market for the period 1962-1966 for concentrates derived from already developed ore reserves," and at the same time to "guard against serious overproduction which might occur under an unlimited purchase program if very large additional uranium discoveries are made."

With respect to ore reserves developed from now on, Foster said the AEC "will make contracts to purchase concentrates to the extent that requirements dictate and on such terms and conditions and at such prices as the Commission may from time to time agree upon."

Foster added that, under the revised program, "protection will be given the independent miners by incorporating in all new milling contracts and extensions to existing milling contracts provisions designed to provide independent mine owners a fair share of available milling capacities."

Buying policies from now until 1962 are not affected by the new policy. Under existing contracts, annual concentrate production is expected to run about 20,000 tons by 1962, with privately owned uranium mills processing about 23,400 tons of ore daily.

GAS PIPELINE EXPANSION EXPECTED

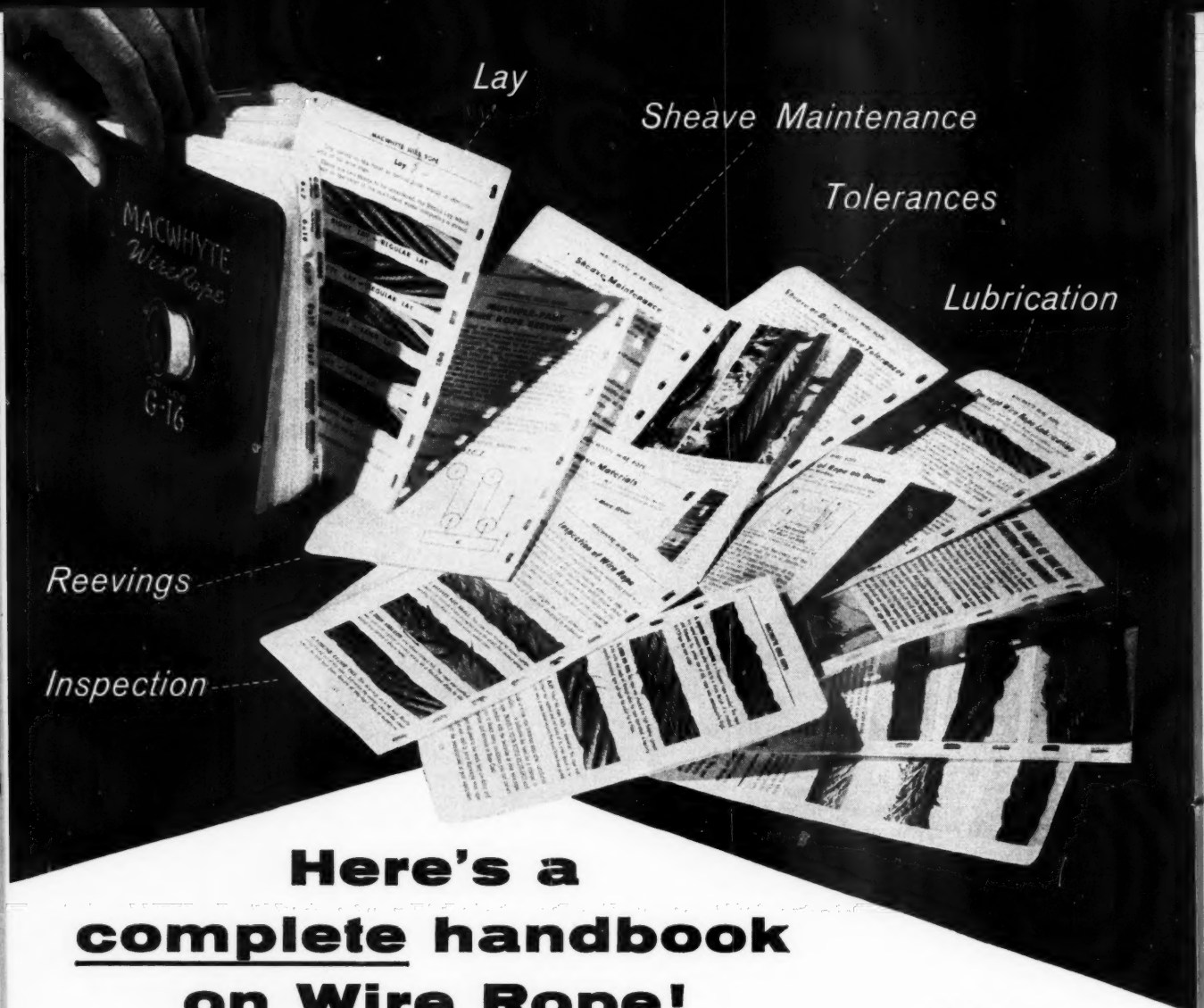
A recent ruling of the U. S. Supreme Court holding that gas pipeline companies may put rate increases into effect without customer agreement, pending Federal Power Commission review of the increases, is expected to spur natural gas pipeline expansion.

A lower court had previously held that proposed gas rate increases could not be put into effect without customer agreement until after the FPC had reviewed and approved the increases. It had been estimated by FPC that over $222 million of proposed natural gas pipeline construction was dropped following the lower court's ruling.

MINERAL PURCHASE PROGRAMS END

In accordance with an announcement early last month by the General Services Administration, current Government programs for the purchase of chrysotile asbestos, acid-grade fluorspar, and domestic and Mexican mercury were terminated December 31. Final figures on purchases under these programs are not yet available, but GSA announced

(*Continued on page* 74)



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MACWHYTE WIRE ROPE

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personals

Cris Dobbins, president of Ideal Cement Co., Denver, recently was elected chairman of the board of directors of the Portland Cement Association at its annual meeting in Chicago. Dobbins, who has served on the board of directors and as a member of various committees since 1948, succeeds **George E. Warren,** president of Southwestern Portland Cement Co., Los Angeles, chairman of the board of the Association during the past two years.

Nine new directors were also elected by Association members at their annual meeting. They are **Charles Baumberger, Jr.,** president, San Antonio Portland Cement Co., San Antonio, Texas; **Ben W. Calvin,** president, Aetna Portland Cement Co., Bay City, Mich.; **Richard A. Grant,** executive vice president, California Portland Cement Co., Los Angeles, Calif., and Arizona Portland Cement Co., Rillito, Ariz.; **M. E. Grunewald,** president, Coplay Cement Manufacturing Co., Coplay, Pa.; **R. D. Raff,** president, Diamond Portland Cement Co., Middle Brancy, Ohio; **Erik Thune,** president, National Portland Cement Co., Philadelphia, Pa.; **Walter H. Wulf,** president and general manager, Monarch Cement Co., Humboldt, Kan.; **B. F. Cox,** vice president, British Columbia Cement Co., Ltd., Victoria, B. C., Canada, and **H. B. Robeson,** president, Nazareth Cement Co., Nazareth, Penn.

From left to right: George E. Warren, Cris Dobbins, and G. Donald Kennedy

The Portland Cement Association, a national organization to improve and extend the uses of portland cement and concrete, is voluntarily supported by more than 70 companies manufacturing portland cement in the United States and Canada. Its activities are limited to scientific research, development of new or improved products and methods, technical service, promotion and educational effort, and safety work.

Professor Ian Campbell of the California Institute of Technology has been named chief of the California Division of Mines. Campbell placed first in a competitive examination for the post and was recommended by the State Mining Board. He succeeds Olaf P. Jenkins who retired in March of last year. Campbell received his undergraduate training at the University of Oregon and a doctor's degree from Harvard. In 1931 he joined the teaching staff at CIT, and in 1952 was made executive officer of the Division of Geological Sciences at that school.

R. S. "Bobbie" Walker, Cleveland, consultant for The M. A. Hanna Co., after completing 50 years of service with the company on August 1, retired at the end of the year and headed for his new winter home on Lake Ola at Tangerine, Fla. At a retirement party held in Cleveland, he was presented with a suitably engraved gold watch by George M. Humphrey, Hanna's board chairman.

Bobbie Walker played an outstanding part in the advance of mining technology in the Lake Superior district as well as other mining regions in the United States and Canada. He supervised construction of the first jig mill in the Ishpeming, Mich., district in 1910. Other original applications which he pioneered were the first electric shovel on the Mesabi Range in 1920 and the first standard gauge electric haulage in 1924. He made a number of contributions to the early success of mechanical mining and mechanized cleaning in the soft coal industry. When the Quebec-Labrador iron ore development was in its early stages, he was responsible for the original design used in the belt-type ship loading dock at Sept Iles.

Allan Shivers, formerly Governor of Texas; **Leslie M. Cassidy,** formerly chairman and president of Johns-Manville Corp.; and **John A. Hill,** president of Air Reduction Co., Inc., were elected recently to the board of directors of Texas Gulf Sulphur Co., Houston.

John F. Lane of the Washington law firm of Gall, Lane and Howe has succeeded **Walter R. Thurmond** of Charleston as secretary of the Southern Coal Producers Association. Thurmond, secretary of the organization since its formation in 1942, retired November 1.

Thurmond entered the bituminous industry as an employe of a coal company at Red Star in Fayette County, W. Va., in 1896. Except for two short periods, he spent his entire career in the coal industry. He once was president of Thurmond Consolidated Coal Co. and the Argyle Coal Co., both Logan County operations, and he served for two years as president of the Logan Coal Operators Association.

Appointment of **James W. Townsend,** Denver mining engineer, as executive officer of the Office of Minerals Exploration Field Team in Region III was announced recently by the Department of the Interior. OME is the successor agency to the Defense Minerals Exploration Administration.

In his new assignment Townsend, who has been employed in the Denver field office of DMEA-OME since December 1951, will fill a vacancy created by the death of William H. King in June. Townsend will direct OME operations in an eight-state area, including the Dakotas, Wyoming, Nebraska, Utah, Colorado, Arizona, and New Mexico.

C. Dewitt Smith has resigned his position as executive vice president in charge of mining operations for White Pine Copper Co. to start a consulting practice of his own with headquarters in Boston.

Carl E. Barnes has been elected vice president for research for Minnesota Mining & Manufacturing Co. Succeeding Barnes as director of central research will be **John W. Copenhaver,** who has been associate director of the company's research department.

Merlyn Woodle, Babbitt, Minn., has been appointed acting manager of the Babbitt Division of Reserve Mining Co. Woodle, who has been assistant manager of that division, takes over the duties of **Floyd W. Erickson,** former manager, who resigned for personal reasons.

James L. Mauthe, chairman of the Youngstown Sheet and Tube Co., has been chosen to receive the Benjamin F. Fairless Award of the American Institute of Mining, Metallurgical and Petroleum Engineers. He will receive the award at the institute's annual meeting in San Francisco in February.

The Fairless award recognizes achievement in iron and steel production and ferrous metallurgy. Mauthe will be cited for "his early contributions to improve efficiency of blast furnace operations and masterful guidance of the steel company which he now heads."

William R. Bond has been advanced to president of **Woodward Iron Co.**, succeeding **John E. Urquhart** who has been named chairman fo the board. **John W. Hager** was named vice president in charge of mining operations at Woodward Iron; **D. T. Turnbull** is new vice president and secretary, and **W. R. Cottrell** was elected treasurer.

Roger M. Wolcott has been named to the newly created position of assistant works manager-project development at the Cleveland Works of Jones & Laughlin Steel Corp. Wolcott formerly was assistant to the vice president-engineering and plant at J&L's general office in Pittsburgh.

W. A. Boyer has been named manager of The Bunker Hill Company's new industrial engineering department. He formerly was engineering superintendent for the plant engineering department. Boyer's new department will make studies in modernization and improvement of plants and methods.

Obituaries

Clinton H. Crane, 85, for many years president, and recently chairman of the board of the St. Joseph Lead Co., died December 1 in Rockport, Me. An outstanding figure in the lead mining and smelting industry, Mr. Crane retired as chairman of the board of St. Joseph Lead Co. in May, 1957. He continued as a trustee of the company, however, and never lost his keen interest in company affairs. Perhaps best known for his consolidation during the 1920's of several Southeast Missouri mining companies into a single efficient mining property, he maintained concurrently an active interest in marine architecture, which led in 1929 to his designing the "Weetamoe," one of the four American contenders for the honor of defending America's yachting honors.

Mr. Crane graduated from Harvard University in 1894, and thereafter spent three years studying engineering and naval architecture at the University of Glasgow, Scotland. His early professional experience centered around designing yachts and high speed motor boats. In 1913, Mr. Crane became president of St. Joseph Lead Co., a position which he held until 1947 when he became chairman of the board. Under Mr. Crane's direction, the company became the largest single producer of lead in the United States.

When the Lead Industries Association was formed in 1928, Mr. Crane became its first president, and served in that capacity until 1947. Throughout his career he received many honors, including an honorary Doctor of Science degree from Colorado School of Mines and the William Lawrence Saunders Medal of the AIME in recognition of his achievements in the mining industry.

Hooper Love, 70, of Nashville, Tenn., retired president of West Kentucky Coal Co. died November 28 following a stroke. Mr. Love was first introduced to the coal business in 1905 when he went to work for his father at St. Bernard Coal Co. in Nashville. He became president of the firm in 1938. Mr. Love had also served as a director of the National Coal Association.

Herman A. Prosser of New York, retired vice president of American Smelting and Refining Co., died November 22, at the age of 83.

Edwin H. Fuertinger, 50, executive vice president of Maust Coal and Coke Co. and the Saljoan Coal and Coke Corp., of New York, died of a heart attack November 14.

Russell C. Fish, 59, vice president, The M. A. Hanna Co., Cleveland, died unexpectedly November 12 at his home in Grand Rapids, Minn. (he also maintained a home in Cleveland). Mr. Fish graduated from Case School of Applied Sciences in 1922 and started his career with Hanna in the Michigan district immediately after graduating as a mining engineer. In 1925 he became chief engineer of the same district, and was made general superintendent of the company's Minnesota mining operations in 1941. In 1946 he was made general manager of the company's entire mining operations. Mr. Fish was elected vice president of Hanna Coal and Ore Corp. in 1956, and was elected vice president of The M. A. Hanna Co. in 1957.

M. C. Dalton, Sr., 69, a master mechanic with Tennessee Copper Co., died November 20. He had almost 49 years of service with the company.

J. Leroy Harless, 59, mining engineer for Kentland Coal and Coke Co., died November 22 at his home in Charleston, W. Va.

Edward Lasko, Sr., 41, general superintendent of Sarver Coal Co., died November 8 in Tarentum, Pa.

Paul C. Beutel, 53, suffered a fatal heart attack November 23 at his home in New Philadelphia, Ohio. He was manager of Columbia-Southern Chemical Corp. coal mines at Midvale, Ohio.

Joseph H. Parsons, 68, a retired vice president of the Brake Shoe and Castings Division of the American Brake Shoe Co., died November 21 after a long illness. His home was in Long Island. A 1913 graduate of Princeton University, Mr. Parsons joined American Brake Shoe that year. He became an assistant vice president in 1943, and served as a vice president from 1949 until his retirement in 1955.

Robert Dixon Jarrell, 68, of Wilkinson, Logan County, W. Va., died November 25. He was a retired mine foreman with the Omar Coal and Coke Co.

Captain Thomas Maunders, one of Quincy Mining Company's most prominent underground supervisors, died October 25 after a lengthy illness. He was born in Cornwall, England, and came to the States at the age of 18. He first settled in Iron Mountain, Mich., where he was employed for three years, and then moved to Ely, Minn., for mining employment. In 1892 he moved to the Copper Country of Michigan where he soon became identified with the Quincy Company.

Alfred T. Anderson, 58, long associated with the Inland Steel Company's iron mining on the Cuyuna range, died of a heart attack on November 9 in his home in Ironton, Minn.

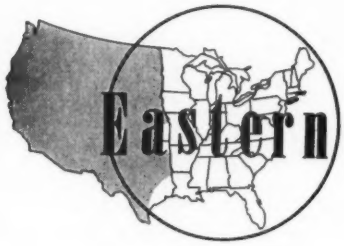
William Rennie, 74, resident of Shadyside, Ohio, and for many years president of R. and P. Coal and Development Co., died November 18 following a short illness.

James P. Dabney, 69, of Charlestown, W. Va., died November 24 after a brief illness. He was a retired mine superintendent for Hatfield Campbell's Creek Coal Co.

Arvid R. Anderson, 68, died November 18 at his home in Delaware County, Ohio. Mr. Anderson was retired manager of Jeffrey Manufacturing Co. and a graduate of the University of Illinois.

William Whiles, 87, veteran Erie, Colo., mining man died November 13.

NEWS and views



IMC Announces Consolidation Program

International Minerals & Chemical Corp., Chicago, announced today it had put into effect a consolidation program which will streamline its organization and "effect greater efficiency of operation, improved customer service, and a stronger marketing position."

The move, announced by President T. M. Ware, brings the phosphate chemicals and phosphate minerals divisions into a single phosphate unit and consolidates research and engineering into one staff division handling research, engineering and development.

George W. Moyers, vice president, heads up the new phosphate division, and I. Milton LeBaron, research vice president, will direct the newly created staff unit. Howard F. Roderick, who has headed the phosphate chemical division since its organization in 1953, has resigned to become vice president and director of Miles Laboratory, Elkhart, Ind., and president of its new chemical division. William Bellano, formerly in charge of IMC's engineering division, was recently elected president of Gulf Sulphur Corp.

Ware said the reorganization, under consideration since early 1958, centralizes responsibilities and planning in the operation and staff areas where such concentration is advisable.

He explained that combining the phosphate divisions "will facilitate expansion to meet the increasing demand for phosphate materials." The two divisions operate in the same markets in some cases, he said, and phosphate rock produced by the minerals division is used to make phosphate concentrates produced by the phosphate chemicals division. Sales of these concentrates were up 20 percent in 1958 with continuing rises "clearly indicated." The phosphate consolidation will not affect the company's sales organization in the various markets.

Combining the research and engineering divisions was described by the IMC president as a "natural evolution growing out of the increasingly rapid pace at which today's research findings must be translated into engineering and development action." The new division will incorporate five groups under LeBaron: research, patent management, mining and exploration, engineering, and development.

George Moyers, a graduate of the U. S. Naval Academy, joined IMC in 1927 as an engineer in Florida, and in 1940 became acting manager of the company's phosphate operations at Columbia, Tenn. He came to Chicago as sales manager for phosphate rock operations in 1941, and became a vice president in charge of phosphate activities in 1952.

I. Milton LeBaron, who joined IMC in 1942 and directed the company's Florida research activities at Mulberry, Fla., became director of research in 1951 and a vice president in 1957. He holds a doctorate in metallurgical engineering from the Colorado School of Mines.

New Jersey Zinc President Establishes Scholarship

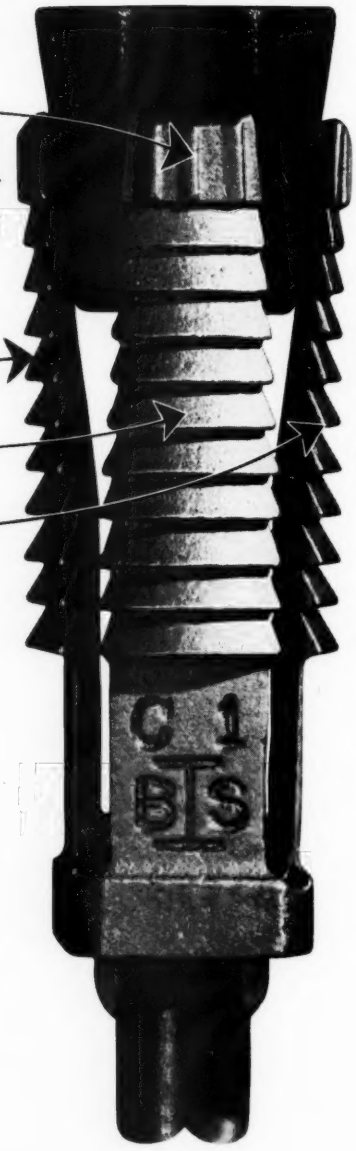
Lehigh University has received $10,800 to establish a scholarship endowment fund from Raymond L. McCann, president of the New Jersey Zinc Co. Trustees of the university have set up the fund as the R. L. McCann Scholarship, and the amount of the award will depend on income available from the fund and the qualifications of the candidate or

(*Continued on next page*)

Quarry Expansion

A three-year expansion program designed to tap an additional 150,000,000 tons of crushed stone for industrial purposes has been announced by Curt Knoblock, general manager of Drummond Dolomite, Inc. The newly-acquired deposits are in the Huron Bay area on the south shore of Drummond Island, Mich., and are six miles east of the company's present dolomite processing plants on the St. Mary's River at the head of Lake Huron. Clearing of timber in the Huron Bay area already has started and the engineering firm of Walter H. Knapp, Inc., has been engaged to make surveys for location of a railroad to connect the new deposits with the processing plant. Total cost of the project is estimated at $2,500,000. Drummond Dolomite now processes ten sizes of crushed stone for the metallurgical, chemical and construction trades at the rate of 2,500,000 tons per year.

Here's where it takes hold



This is the expansion shell used on the end of a Bethlehem Headed Roof Bolt. Inserted in a hole drilled into the mine roof, the serrated leaves of the shell expand quickly when the tightening of the bolt draws the plug down on the threads. In a matter of seconds, the shell and bolt are locked in the hole, thus providing a firm, secure roof.

HEADED BOLT COMES IN 3 SIZES

The Bethlehem Headed Roof Bolt, used with the malleable-iron shell, is furnished in three diameters, each of which is made in varying lengths. The ¾-in. carbon bolt and the ⅝-in. high-strength bolt have a typical breaking load of 24,000 lb; and the ⅞-in. high-strength bolt has a typical breaking load of 45,000 lb.

We also manufacture a 1-in. slotted roof bolt, which is used with a steel wedge. Either bolt, headed or slotted, can be used with square plate washers, angle washers, or roof ties.

Why not include roof bolting as part of your safety program? If you will contact the nearest Bethlehem sales office, we'll arrange to have an experienced engineer discuss bolting techniques at your properties, and render assistance to bolting crews.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

(*Continued from previous page*)

candidates. Under terms of the new endowment, the scholarship is to be awarded to a student seeking a degree in one of the engineering departments at Lehigh, with preference being given to mining or metallurgical engineering.

McCann, who was graduated from Lehigh with a degree of Engineer of Mines in 1917, has been with New Jersey Zinc since his graduation. He progressed through various divisions of the organization to become its superintendent in 1930. He was made general manager of mines for the company in 1939, vice president in 1950, and president in 1951.

Also . . .

Jones & Laughlin Steel Corp. has started construction of a new battery of by-product coke ovens at its Pittsburgh Works. The new battery will consist of 59 Wilputte ovens with a rated monthly capacity of approximately 30,000 tons of coke.

One of the largest strip coal mine operations in Alabama is now under way in southwest Winston County, by the McCoy Brothers Coal Co. of Jasper. John and Dewey McCoy purchased 6000 acres and now have four dragline machines removing surface dirt from the coal beds. Production of coal should be between 1000 and 2000 tpd. Company officials estimate there are 30,000,000 tons of coal in the nine sq mi of mining land.

A group of investors, including Canadian Johns-Manville Co., Ltd., has joined with Advocate Mines, Ltd., of Toronto to develop an asbestos ore body in the Baie Verte region, on the northeast coast of Newfoundland. Canadian Johns-Manville, which mines asbestos in Quebec and northern Ontario, has contracted to manage and operate the Newfoundland project with technical help from its associates. Exploration and development work is expected to require about two years, and construction of a mill and other facilities an additional year and a half. The mill will have an initial capacity of 3000 tons of ore per day.

Breaking-in operations of one of the three sintering lines at U. S. Steel Corporation's new Saxonburg sintering plant have begun. The second and third machines are expected to be completed by the end of the year. One of the largest such installations in the nation, the Butler County, Pa., plant will process 15,000 tons of domestic and foreign iron ores a day when in full operation.

A $275,000 expansion and improvement program will begin soon at the National Gypsum Co. plant at Niles, Ohio. The project will include an 18,000 sq-ft building addition and additional warehousing facilities. The new project is the fourth undertaken by the company at its local plant during the last five years.

Youngstown Coal Pipe Lines Co., a new concern, has been incorporated to build a pipeline to transport coal from some Ohio mines into Youngstown, Ohio. The facility will be similar to the 105-mile Hanna Coal Co. line between Georgetown strip mines and the Cleveland Electric Illuminating Company's Eastlake power plant near Cleveland.

Aluminum Co. of America is building a new unit at Alcoa, Tenn., to produce colored enamel-coated aluminum sheet reportedly wider than now available. A 400-ft long building, scheduled for completion next spring, will house modern automated equipment for priming and enameling sheet coils wider than 60 in. in a continuous cycle.

Alabama By-Products will take over construction and operation of a multi-million-dollar coal mine near Parrish, Ala., for the Southern Electric Generating Co., according to a recent announcement. The mine will supply coal for the 1,000,000-kw capacity steam electric generating plant which Southern is constructing at Wilsonville. Construction of the mine already has begun. When completed it will have a capacity to produce 1,500,000 tons of coal a year and employ 400 men. Southern Electric is owned jointly by the Alabama and Georgia Power Companies, operating subsidiaries of the Southern Co.

Establishment of a new company, Mineral Mills, Inc., to produce and sell finely ground magnetite for dense media plants cleaning coal and other minerals has been announced. The company has offices in Mt. Lebanon, Pa., and is now setting up a pair of ore pulverizing mills in building space leased from the McKees Rocks Industrial District. These two machines will have a monthly capacity of 1000 tons of magnetite. After drying and pulverizing, the magnetite will be packed in 100-lb bags for shipment either by truck or by rail. Earl C. Payne, for many years a consulting engineer with Consolidation Coal Co., is president.

An enlarged and revised bibliography on a liquid-solid cyclone has been completed by minerals beneficiation specialists at Battelle Memorial Institute. Prepared by Oscar F. Tangel, Robert J. Brison, and Daniel A. Jacobs, the new bibliography lists 243 articles on the liquid-solid cyclone that were published from 1939 through 1957, with some early 1958 entries included. Copies may be obtained without charge by writing to the Publications Office, Battelle Memorial Institute, 505 King Ave., Columbus 1, Ohio.

The Eighth Annual Drilling and Blasting Symposium, presented by the School of Mines & Metallurgy and the Center for Continuation Study of the University of Minnesota, and sponsored jointly by the University of Minnesota, Colorado School of Mines and Pennsylvania State University, was held on the University campus in Minneapolis on October 2-4. It followed the previous trends of combining the knowledge and talents of research and development with those in operations in order to solve the problems of drilling and blasting. The papers and discussions will be published in the forthcoming Proceedings of the Symposium. Those interested in purchasing copies should contact the Center for Continuation Study at the University of Minnesota.

Oolite Mineral Corp. plans to start mining operations soon at Anderson, Stewart and Dover, Tenn. Minerals mined will include lime, calcium and magnesium. Plans call for construction of a cement plant to use some of the output. Other materials will be sold to chemical and fertilizer plants.

Substantial increases in U. S. production of aluminum and bituminous coal were recently predicted for 1959. The forecasts were made at a University of Pittsburgh conference by George A. Lamb, manager of business surveys of Consolidation Coal Co., and E. M. Strauss, Jr., who holds a similar position with Aluminum Co. of America. The annual conference is sponsored by the University to explore business prospects and major industries for the coming year.

Georgia Marble Co. of Tate, Ga., in its explorational core drilling program at the Willingham-Little Stone Co. Division, Whitestone, Ga., has drilled vertically to a depth of 700 ft in the Murphy marble bed. This is thought to be the deepest penetration ever made in that formation.

The National Technical Task Committee on Industrial Wastes held its annual meeting in Cincinnati, Ohio, on December 11-12. This committee was organized in 1949 as a result of the Federal Water Pollution Control Law of 1948. It is an advisory group to the U. S. Public Health Service and to the President's Water Pollution Control Advisory Board. NTTCIW is composed, at present, of 62 members and alternates; representing 32 of America's major industries. It thus provides an industry-wide viewpoint to advise Federal agencies on their stream pollution abatement programs. The mining industry is represented by Professor C. Fred Gurnham, Head of the Department of Chemical Engineering at Michigan State University, and Henry F. Hebley, of Consolidation Coal Co.

Republic Steel Corp. has reopened its Newfield coal mine at Verona, Pa., on a limited basis. Increased demand for coal resulting from a boost in steel production led to the reopening of this operation.

About 3000 acres of ilmenite-bearing land in west Tennessee has been leased by the E. I. du Pont de Nemours & Co. Ilmenite is the primary raw material for titanium dioxide, to be produced at the du Pont plant at New Johnsonville, Tenn.

1959 AMC COAL SHOW

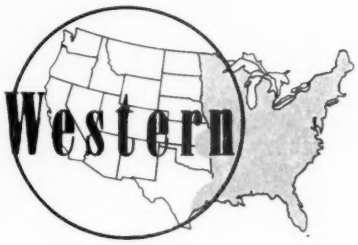
FORWARD-looking coal mining men who are setting their sights on increased profits in 1959 are now making plans to be at the 1959 Coal Show of the American Mining Congress in Cleveland, May 11-14. They know that the opportunity to study all the improvements and new developments in mining equipment, and to hear industry leaders describe recent advances in the art of coal mining, will be a tremendous aid to them in making their own operations safer and more efficient.

AMC Coal Shows have been likened to a seminar on modern mining methods and equipment, and the 1959 Show will be the greatest ever. Even at this early date over 135,000 net square feet of floor space have been reserved by 223 manufacturers of mining equipment to exhibit their products—and their engineering specialists will be on hand to discuss the applications of the many cost cutting tools available to the industry.

These advantages can not be obtained in any other way, and progressive representatives from all segments of the industry are resolving to be in Cleveland next May.

Housing is being arranged through the Cleveland Convention Bureau. Write directly to Louise D. Perkins, Director, Hotel Reservation Bureau, 511 Terminal Tower, Cleveland 13, Ohio.

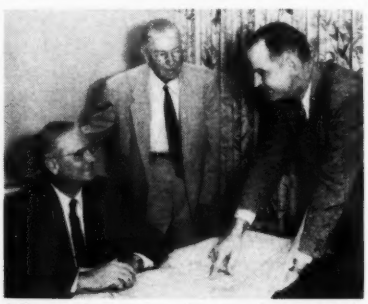
NEWS and views



Major Industry for Verde Valley

The long-hoped-for return of major industry to the Verde Valley became a reality recently along with the birth of a new Arizona company. Donald S. MacBride, president of American Cement Corp., announced the formation of an Arizona-operated division of the corporation which will be known as the Phoenix Cement Co. It will produce and market cement from its new $16,000,000 plant now under construction in Clarkdale.

Other company officers are: Ray R. Adams, Clarkdale, Ariz., president;



Officers of American Cement Corporation's newly-created Phoenix Cement Co.: (left to right) Ray R. Adams, president; W. A. Warriner, assistant to the vice president; and Frank N. Steadman, vice president

Frank N. Steadman, Phoenix, vice president and W. A. Warriner, Phoenix, assistant to the vice president. All three men have spent most of their business lives in the cement industry.

Adams, who will make his headquarters in the new company's general offices in Phoenix, said "Phoenix Cement Co. is the fourth home-operated, autonomous division of American Cement and the first new division since the corporation was formed on December 31, 1957, through the merger of Hercules, Peerless and Riverside Cement Companies."

The company's first big contract is with the Department of Reclamation to furnish 3,000,000 bbl of cement for building the Glen Canyon Dam in Northern Arizona.

Phoenix Cement Co. President Ray R. Adams has served as project manager for the companys' new Clarkdale plant since construction started early in 1958. He has been active in the cement industry for 31 yr, coming up through the chemical departments and later transferring to operations.

Frank N. Steadman, vice president, also comes to Phoenix Cement from Peerless where he served for more than 10 yr as a sales manager with offices in Detroit, Mich.

W. A. Warriner, assistant to the vice president, has served for 35 yr as sales manager of Riverside Cement in Arizona. Warriner, who came to Phoenix in 1918 has long been a well-known figure in the construction industries, and has contributed a great deal to Arizona's industrial progress.

Beryllium Discussed at Meeting

The problems and potentials of the American beryllium industry were outlined recently at a symposium in Loveland, Colo., sponsored by the Beryllium Mining Association. Beryllium, a lightweight metal, is becoming increasingly important; but several properties of the metal severely limit its use in atomic reactors, instruments, parts for rockets, satellites and other modern weapons.

Franklin P. Huddle, a member of the research and engineering staff of the U. S. Defense Department, said beryllium's resistance to corrosion, stiffness, lightness and strength; its ability to withstand temperatures up to 2300°F without melting; its nonmagnetic qualities, and its ability to absorb energy, make it a very important metal. He pointed out however that its rarity, poisonous characteristics, the difficulty in extracting the ore from the earth and the metal from the ore, make it expensive and severely limit its use. The Government has been paying $60 a pound for beryllium.

Dr. Herbert E. Stokinger, chief toxicologist for occupational health, U. S. Public Health Service, said that the metal and its compounds cause a disease similar to tuberculosis, but much more serious. The disease, called beryllosis, is contracted by breathing metallic beryllium dust, or dust from materials containing two percent or more beryllium, for a prolonged period of time. Stokinger added that the poisonous effects of beryllium can be controlled.

Ray Mines Smelter and LPF Plant Finished

The newest major additions to Arizona's copper production installations, Kennecott Copper Corporation's new Ray Mines Division smelter and leach-precipitation-flotation facilities, were dedicated recently in ceremonies which marked the end of more than two years of construction.

The new smelter is a part of Kennecott's current $40,000,000 program for expansion of Ray Mines Division production facilities. The program includes the smelter, expansion of concentration mill facilities at Hayden, and enlargement of the Ray pit. The expansion program will permit a 50 percent increase in production from the Ray pit, and approximately a 40 percent increase in blister copper production over the 1956 rate. The difference between the increase in the rate of mining and copper production results from the continued lowering of the ore-grate at Ray. The ore now contains less than one percent copper, or 18 lb of copper to the ton of ore mined.

The integrated leach-precipitation-flotation facility, producing its own sponge-iron and sulphuric acid from the pyrite in Ray ore, is unique in Arizona, and the second of its type in the world. The L-P-F plant makes possible the recovery of oxide copper minerals from the Ray ore. The Ray mine contains principally sulphide copper, but the recovery of non-sulphide copper minerals is expected to produce an average of an additional two lb of copper from each ton of ore.

ALSO . . .

A 20 percent increase is planned in the capacity of the soda ash mine and production plant of Intermountain Chemical Co. near Green River, Wyo. The expansion should be completed by early 1959.

Colorado mining men are currently laying plans for a gala celebration next year to mark the 100th anniversary of the discovery of gold in the State. The Denver Mining Club, in cooperation with the committee of the 1959 "Rush for the Rockies" centennial, has rented for the entire year the big room formerly used by the Colorado Mining Stock Exchange on the second floor of the Mining Exchange building and will fit it up as a headquarter for mining interests.

The Club plans to have exhibits of Colorado minerals on display and also samples of ore available to give to tourists and others interested in mining. The room will be available for lectures and other meetings in connection with mining. Relics, old records, pictures and other items of interest will be exhibited, and literature describing the centennial will be available.

A $6000 scholarship fund has been established by Mrs. Alma R. Kingsbury, widow of the late Henry B. Kingsbury, Wallace mining man and stock broker. Purpose of the fund is to assist young people from the Coeur D'Alene mining district to attend college. Kingsbury's mining interests included Independence Lead, Silver Syndicate, Clayton Silver, and United Lead-Zinc. Mrs. Kingsbury has retained an active interest in mining affairs and is currently a director of the latter three companies.

A new cold bituminous concrete paving material called "Gilsapave", which makes possible cold patching of chuckholes and other pavement defects during the winter, has been described as an important new use for the mineral Gilsonite, a natural hydrocarbon found in the Uintah Basin of Utah. It is being manufactured by the Asphalt Paving Co. in Denver and is distributed through George M. Jones Co. of Salt Lake City.

A shaft sinking rate of 15.7 ft each 24 hr was established recently by Shattuck Denn Mining Co. on a uranium property about 30 mi east of Monticello, Utah. Company officials say this is a record on the basis of ft per day for the Western Hemisphere. Aided by special mechanized equipment, the small 13 by 7-ft shaft was pushed down as much as 20 ft per day during one 4-day period. In one 24-hour period, the miners drove 24 ft which included blasting, mucking, and hoisting rock to the surface. Full depth of the shaft is 850 ft.

Specialized equipment used by Shattuck Denn included a 4½-ton Cryderman mucking machine, a collapsible jumbo which handled four drills, a very high-speed assembly for hoisting rock, and a special ventilation system that cut down-time to eight minutes after blasting.

One of the highlights of the national meeting of the AIME at San Francisco, February 15 through 19, will be a Symposium on Exploration. Topics under discussion will include every phase of exploration, and members of management, geologists, geophysicists and geophysics and geochemists will be represented on the panel.

Also of particular interest to convention-goers will be a talk by Edward Teller, famous atomic energy authority and University of California physicist. He will speak on "Peaceful Uses of Nuclear Explosives" at a dinner meeting of the AIME Council on Education on February 15.

A state minerals industry building, to house college engineering departments and laboratories for the New Mexico Bureau of Mines and Mineral Resources, has been proposed for the New Mexico Institute of Mining and Technology.

The building—expected to cost about $500,000—would contain the college's petroleum, metallurgical and mining engineering departments, and would provide facilities for ore testing and research on ores now considered too low grade for commercial use. The structure would facilitate plans for expanding the services of the Bureau of Mines and provide better classroom and laboratory space for the college.

Private industry had an investment of $134,928,000 in uranium mills in the United States as of November 1, 1958, according to the Grand Junctions Operations Office of the Atomic Energy Commission. Of this amount, $112,828,000 is invested in completed mills and $22,100,000 in three mills under construction.

Use of protective equipment has brought good results at the Chino Mines Division of Kennecott Copper Corp., Hurley, N. M. Safety glasses, for example, were greatly instrumental in reducing eye injuries during the year. In 1957, there were 127 no-lost-time injuries to the eye and four lost-time injuries. In 1958, the figure was reduced to 29 no-lost-time injuries and one lost-time. Foot injuries were decreased from 14 to four in the no-lost-time category, and from six to none in the lost-time classification. The use of hard-toed shoes was given credit for this record. A hard hat program, instituted in 1956, has probably been responsible for a sharp reduction in head injuries, according to W. H. Goodrich, Chino general manager. In 1956, 46 no-lost-time and three lost-time head accidents were reported. In 1957, the no-lost-time head injuries dropped to 33, and there were zero lost-time accidents in this category. Late in 1958 there had been no head injuries reported.

Riverside Cement Co., a division of American Cement Corp., has purchased properties containing raw materials suitable for the production of the high quality white portland cement. The purchase is the result of extensive exploration work covering the entire Southern California area and an intensive drilling program covering the past several months. The properties involved are in close proximity to the company's Crestmore plant near Riverside where the new product will be manufactured. Tentative orders for production equipment are being placed with F. L. Smidth & Co. of New York and Copenhagen.

Not only will the multimillion dollar plant be the only facility in Southern California for the production of white cement, but the only plant of its type west of the Rocky Mountains. For the past several months, Riverside has been engaged in exhaustive studies relative to the production of white cement, and its facility will incorporate the latest techniques of burning, grinding and quality control procedures.

A unique research project, conducted in Grand and San Juan Counties of Utah, reveals the important role of mineral development to a State's entire economy. As a result of the studies, researchers came up with the conclusion that for every 100 miners employed in the counties, jobs were provided for 84 other persons in service industries (e.g., construction, trade, transportation, finance, Government, schools, etc.). The survey, however, did not include jobs resulting from the huge purchases by mining companies of goods produced outside of the counties. Only about 40 percent of mining expenditures for supplies and material were made in the two counties.

Because of its relative isolation, the Grand-San Juan area furnishes a very accurate index of dependence on mining.

A new stationary hearth electric furnace for production of elemental silicon is being added by National Metallurgical Corp. at their Springfield, Ore., plant. The new furnace will go on stream next July and will cost about $500,000. Raw materials for the plant include silica, coke and wood chips.

WHEELS OF GOVERNMENT

(*Continued from page* 63)

that cumulative purchases as of September 30 were as follows (the total limitation on each program is shown in parentheses):

Crude No. 1 and No. 2 asbestos, 1,514 short tons (2,600 tons); crude No. 3 asbestos, 923 short tons (2,188 tons); acid-grade fluorspar, 111,907 short tons (172,300 tons); domestic mercury, 9,607 flasks (30,000 flasks); and Mexican mercury, 1,387 flasks (20,000 flasks).

MERCURY STUDY COMPLETED

The U. S. Tariff Commission has completed an investigation of the conditions of competition in the United States between mercury produced in the U. S. and in foreign countries, and has submitted a comprehensive report on its findings to the Senate Finance Committee.

Undertaken at the request of that Committee, the months-long study included a public hearing last August in Washington, D. C., at which seven representatives of the domestic mercury mining industry testified.

Investigations of this type do not call for any Commission recommendations as to tariffs or other import controls, that could constitute the groundwork on which future Administration or Congressional action might be based.

A similar report was recently made with respect to the tungsten industry.

BLM NAMES DENVER MANAGER

New manager of the Bureau of Land Management's Land Office in Denver, Colo., is Dale Andrus, formerly assistant manager of the Land Office in Los Angeles, the Department of the Interior announced last month.

Andrus, a forestry graduate of the University of Idaho, joined BLM's office in Prineville, Ore., in 1953 as a range conservationist.

manufacturers forum

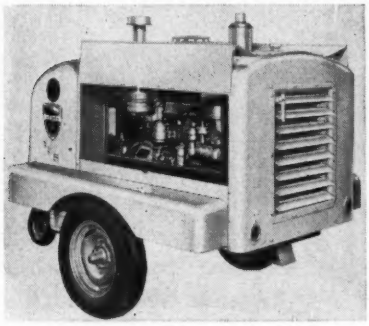
Hydraulic Power From an Electric Source

A LINE OF SELF-CONTAINED, versatile power packages producing hydraulic power from an electric source is now available from Wooster Division, Borg-Warner Corp., Wooster, Ohio. The package incorporates an electric motor, hydraulic gear pump with integral relief valve, check valve and reservoir in one assembly. Pressure loaded bearings, a patented feature of Wooster, automatically compensate for wear to assure high volumetric efficiency and longer life, according to the manufacturer.

The Wooster package is said to be designed to handle a wide variety of work loads, even loads as great as those encountered in such equipment as snow plows, tailgate loaders, tractors and lift trucks. Capacity of the gear pump ranges from 0.36 to 0.80 gpm. Reservoir capacity ranges from 0.43 to one gal. The Wooster line of motors may be open-ventilated, totally enclosed, or standard starter type motors. They are available for operation from a six, 12 or 24-volt d-c source. Shaft rotation is available for operation in either direction or can be reversible for greater versatility.

Rotary Air Compressor

THE LIGHTEST (2250 LB) and slowest (1600 rpm) 125 cfm rotary portable air compressor on the market is the way Le Roi describes the fourth of its new line of rotary air



compressors. The 125 RG2 is a sliding vane type two-stage compressor with an in-line cylinder arrangement. It is rated at 125 cfm of free air compressed to 100 psi.

The compressor is powered, by direct drive, with a Le Roi engine which is a wet sleeve overhead valve engine of proven design. A 100 percent capacity modulating control matches air supply to air demand within a pressure range of 10 psi. "One-valve" air pressure adjustment is provided.

The engine-compressor is supported on a welded steel frame of unit construction and is enclosed in a lockable steel metal housing. Three-point suspension reportedly protects against towing distortion over rough terrain.

For more detailed information write the Sales Promotion Department, Le Roi Division, Westinghouse Air Brake Co., Milwaukee 1, Wis.

Inquiries about new equipment appearing in Manufacturers Forum are welcomed. For additional information on any piece of equipment in this section write directly to the manufacturer, or to Mining Congress Journal with name of item and date of issue in which it appeared.

Thin Seam Shuttle Car

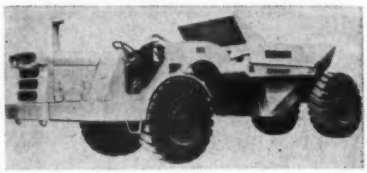
WITH AN OVER-ALL BODY HEIGHT OF 25 IN., the Type 26 TorKar will operate in very thin seams. Units have a basic 110-cu ft capacity which can be increased through use of sideboards—8½ cu ft extra capacity for every inch of sideboard. Only a single a-c or d-c motor is required, with power from the motor transmitted through a torque converter. Other reported design features include three-speed forward and reverse transmission, four-wheel drive and steer, reversible conveyor, simplified controls and high-speed unloading. Additional details may be obtained from National Mine Service Co., 2530 Koppers Bldg., Pittsburgh 19, Pa.

Diesel-Generator Sets

A STANDARD LINE of five to 300-kw engine generator sets are now available through nation-wide network of Allis-Chalmers sales offices. A-c or d-c sets are available in single or three phase, 50 or 60-cycle frequency. Drives are diesel, gasoline, butane or natural gas engines. In addition to the standard models, a high-speed synchronous generator is available with diesel engine drive for 30 to 300-kw standby or continuous service. The generator can be driven at 1200 or 1800 rpm.

Tractor Wagon

DESIGNED TO HAUL ROCK and similar materials that can't be self-loaded by scraper, the 13-ton Michigan Model 110 Tractor Wagon has a capacity of 12 cu yd and 8.3 cu yd struck. In the loading operation the



rear dump's hydraulic system—hoses and piping—are completely shrouded to guard against damage from bouncing rock. Double-bottom construction of the dump body, using three thicknesses of steel, provides extra protection for long service life.

When dumping, double-acting hydraulic cylinders tip load out the rear. The wheelbase shortens as rear wheels and axle pivot forward. Power of the tractor can be used to assist in dumping heavy loads. The operator simply locks air-actuated rear wheel brakes and power-shifts into reverse. The load spills out faster as the 162-hp machine throws its weight and power behind the dumping action.

The tractor on the Model 110 rear dump is identical to, and interchangeable with, the tractor on the Michigan Model 110 Tractor Scraper.

For further information write to Construction Machinery Division, Clark Equipment Co., Pipestone Road, Benton Harbor, Mich.

Rotary Printer

OFFERING 42-IN. AND 22-IN. MACHINES, Reproduction Engineering Corp., Ivoryton, Conn., has announced the 1959 models of the Blu-Ray Rotary Diazo Printer. Scheduled for shipment early in December, the new models incorporate several modifications, all reportedly contributing to increased speed and convenience. Printing speeds are said to have been stepped up 50 percent by a revision of the light source and with an air cooling system to control interior temperatures and maintain optimum lamp temperatures for maximum efficiency and useful life. A belt and pulley drive has improved paper feed. Other Blu-Ray features, including external finger-tip speed control, visual development and ball-bearing suspension of all moving parts, have been retained.

Self-Loading and Self-Dumping Transport

A PNEUMATIC-TIRED four-wheeled self-loading and self-dumping transport has been announced by Sanford-Day Iron Works, Inc., Dale Ave., Knoxville, Tenn. Called the S-D Gismo Transloader, the one-man operated truck can travel up to 20 mph in either direction. The Gismo unit consists basically of a large dipper with teeth, intermediate fold-back mechanism with adjoining and self-contained haulage body, and dump door. The dipper and fold-back action "cascades" material back into the Gismo until the large dipper loads itself, and the entire machine becomes a transport with approximate six-ton payload. Equipped with power brakes, power steering and torque convertor, the self-loading truck can shuttle back and forth between muck pile and the dumping point without the synchronization of several pieces of equipment or positioning of equipment to load, according to the manufacturer.

Dust Collecting Jack Leg Drill

A DRY, dustless jack leg drill eliminates the need of water in drilling and providing a continuous ore sample. The dust collector tank which can be dumped by remote control from the drill is part of the new equipment. Both have been approved by the Bureau of Mines. For more information about the LLV drill and the LX-1 dust collecting tank, write Sales Promotion Department, Le Roi Division, Westinghouse Air Brake Co., Milwaukee 1, Wis.

Mineral Binder

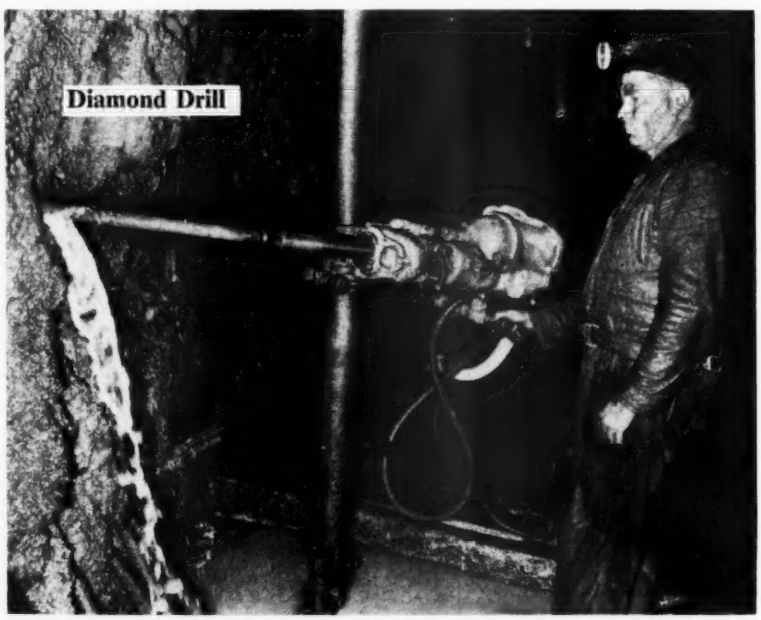
COSTLY LOSSES OF FINE COAL and minerals due to erosion by wind and rainstorm can now be controlled with Aerospray 52 Binder, according to American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y. The mineral binder is a water emulsion of a synthetic resin. It forms a protective crust when sprayed on exposed surfaces of coal and minerals while they lay in open storage or in-transit in open railroad cars. The binder's protective crust is said to be insoluble in water, so that it does not leach away in rain and moisture. According to the manufacturer, tests indicate the Cyanamid binder is non-corrosive and non-toxic.

Permissible Light

AVAILABLE AS EITHER A HOT-SPOT or semi-flood, the PBF-5 is a portable permissible light with official U. S. Bureau of Mines approval. Specifically recommended for many applications in dust or gas-laden areas below or above ground, the unit is of cast and spun aluminum construction throughout, has a high-impact plastic lens, and features a two-filament bulb (one for spare) for added safety. Included is a Carpenter 7½-volt battery pack. The bulb is rated at 27,500 beam candlepower with the hot spot reflector. Total weight including battery is 13 lb. Complete specifications are available from Carpenter Mfg. Co., Bradley St., Somerville 45, Mass.

Fork Lift Trucks

A LINE OF GAS POWERED-electric driven fork lift trucks has been announced by Automatic Transportation Co., 149 West 87th St., Chicago 20, Ill. The gas engine on the new line of Dynamotives transmits its power through a specially designed variable voltage generator to a matched d-c series wound electric drive motor, forming a synchronized power package. This type of drive is said to enable the gas engine to operate at its most efficient speed at all times, resulting in greater fuel savings. Capacities of this line of Dynamotives range from 4000 to 10,000 lb with lifting heights to suit all applications.



RECOMMENDED FOR BLAST HOLE, coring or grout hole work, the CP-65 diamond drill features reversible air motor plus 50 percent boost in power, according to the Chicago Pneumatic Tool Co., 6 East 44th St., New York 17, N. Y. The rotary motor has been made reversible for greater speed in blast hole drilling operations, reportedly permitting rapid unscrewing and screwing of rod joints. The CP-65 is said to be a fully enclosed, dust-proof, oil-tight unit. Ball bearings are used throughout the drill. The unit mounts on a standard rock drill saddle and works in any position from a column, arm or crossbar. The complete drill with a built-in swivel head is 42½-in. long, and weighs 200 lb. An air actuated rod puller is furnished as an extra when required.

HEAVY-DUTY
HYDRASTROKE* FEEDER
FOR MINES and MILLS

A Reciprocating High-Tonnage Feeder easily adapted to feed Belts, Trucks, Skips, Railroad Cars, Screens and Crushers

Check these Outstanding Advantages

☑ HYDRAULIC OPERATION

Exclusive hydraulic power drive supplies the fluid to a cylinder which reciprocates the deck. Fixed or variable feeding rates are easily available through the use of a fixed or a variable volume pump. Length of stroke can be varied from 6 to 24 inches.

☑ MINIMUM HEAD ROOM

Head room requirements are reduced to as little as 20 inches. Impact damage is minimized because discharge lip of feeder is only 6 to 8 inches above lowest clearance line of feeder. Initial construction costs are reduced.

☑ ROCKER MOUNTING OR SUSPENSION

May be installed with either rocker suspension or self-contained rocker mounted units. Eliminates costly wear due to friction which is present in other types of feeders. No lubrication is needed. Feeder can take severe shock loading.

Durability characterized by special rugged construction

Wide range of sizes available . . . widths from 36" to 96" . . . feeding capacities from 300 to 7500 tons per hour.

Write for illustrated brochure.

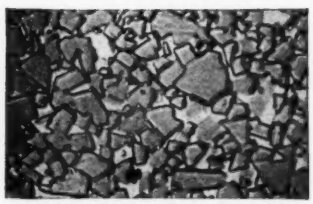
NICO *TRADEMARK

NATIONAL IRON COMPANY

[redacted]

Subsidiary of Pettibone Mulliken Corporation, Chicago 51, Illinois

Longer bit life— with *new* Sandvik Coromant Bits



Sandvik Coromant Tungsten Carbide (Microphoto) Uniformity of size, even distribution of grain are marked. Free from porosity and impurities —therefore stronger, longer-lived.

Low quality Tungsten Carbide (Microphoto) Black marks are contaminations caused by deficient production control. They weaken the carbide, reduce its working life.

Sandvik Coromant Detachable Bits are Available in the following Thread Sizes and Bit Diameters

Type	Thread	Available Diameters, in Inches															
		1⅛	1⅜	1½	1⅝	1¾	1⅞	2	2⅛	2¼	2⅜	2½	2¾	3	3½	4	4½	5
SHOULDER	TAPER	x	x	x	x													
	F		x	x														
	113		x															
	H			x	x	x	x	x		x								
	115			x	x													
	D						x	x	x	x	x	x	x	x				
	K													x	x	x	x	
BOTTOMING	1" Rope				x	x	x	x		x								
	1¼" Rope						x	x	x	x		x		x				
	400						x	x		x		x						
	1½" Rope											x	x	x	x	x		
	600											x	x	x	x			
	700													x	x			
	J7.5															x	x	
	2" Rope														x	x	x	x
	1000																x	

NEXT time you buy bits, specify Sandvik Coromant because they give more footage per bit, lower drilling costs. Here's why:

1 Only first-quality tungsten carbide is used —as shown in the microphotos above. This means less wear, longer life and a better job.

2 The bodies are precision-made of high quality alloy steel—tough enough to take the strain throughout the extra-long bit life.

3 The bigger Sandvik Coromant bits are all of X-design, which prevents rifling. No wonder Sandvik Coromant inserts are the most widely used in the world, drilling more than one billion feet every year.

SANDVIK COROMANT bits are supplied through Atlas Copco, the world's largest manufacturer of rock drills, who also supply Sandvik Coromant integral steels — the most widely used in the world — and Sandvik Coromant extension steel equipment.

Write or phone today for further details to either of the addresses below:

610 Industrial Avenue
Paramus, New Jersey
COlfax 1-6800

Atlas Copco

930 Brittan Avenue
San Carlos, California
LYtell 1-0375

Hoisting and Pulling Machine

A PORTABLE, manually operated, hoisting and pulling machine, the Griphoist T-35 is a companion product of the standard Griphoist and is rated at three-ton capacity. Although the T-35 follows the same basic principal, that is two sets of alternating gripping, self-energizing jaws, it is said to be a completely redesigned unit. The new features are said to include a ball bearing crank, two-speed control, and a self-locking shackle type pin that permits quick anchoring of unit. The machine weighs 60 lb and uses ⅝-in. wire rope. Write for descriptive literature to Griphoist, Inc., 424 Bryant St., San Francisco 7, Calif.

Crane

LIFTS UP TO 5000 LB, requires only 22 in. behind a truck cab; is completely hydraulic, and the boom rotates a full 360°—these are principal features of the Model 50 Hydra-Lift, according to Pitman Mfg. Co., 300 W. 79th Terrace, Kansas City, Mo. The boom can be carried either over the cab of the truck or the bed. The crane has controls on both sides. All boom and loadline actions, or any combination of them, can be accomplished simultaneously. The new crane is available in three models. One has a fixed boom length, 12 ft long. The second has a boom that telescopes manually from 12 to 16 to 20 ft. The third telescopes hydraulically from 12 to 20 ft. Model 50 has hydraulic, "A" frame outriggers; the self-locking type. Power for operation of the crane is derived from the truck, through a power take-off and hydraulic pump. The pump is mounted directly on the power take-off. A five-ft jib is optional; also a personnel platform.

Rust-Resistant Paint

A ONE-COAT rust-resistant paint, recommended for mine applications, has been announced by Speco, Inc. Available under the trade name "Rustrem" (rust-remedy), it is said to be suitable for use on all types of mine machinery, indoors or out; metal buildings, roofs, ventilators, drains and steelwork. According to the manufacturer, it requires no prime coating and can be either sprayed or brushed on, after minimum surface preparation. Rustrem is also claimed to penetrate rust layers and adhere firmly to the base surface, forming a tight seal which resists moisture, temperature changes, chemicals, mild acids and fumes. For complete Rustrem data, write Speco, Inc., 7308 Associate Ave., Cleveland 9, Ohio. Ask for Bulletin RAR-1.

—*Announcements*—

Robert G. Allen has been elected president of **Bucyrus-Erie Co.**, South Milwaukee, Wis. He succeeds **William L. Litle** who will continue as chairman of the board and senior officer.

Raymond E. Melampy has been appointed safety engineer for **Armco Drainage & Metal Products, Inc.**, a subsidiary of Armco Steel Corp. He has been safety advisor to the personal relations department since 1953.

Western-Knapp Engineering Co., of San Francisco, has appointed **Bengt Samuelson**, manager of the Hibbing, Minn., district. In addition to construction and engineering experience in both United States and Europe, Samuelson has also been associated for many years with The Anaconda Co. A recent project under his supervision was the multi-million dollar copper smelter constructed for the Ray Mines Division of Kennecott Copper Corp.

Malcolm P. Parker has been named sales representative for Leschen Wire Rope Div., **H. K. Porter Co., Inc.**, covering the territory of North Carolina, South Carolina, and northern Georgia. He will make his headquarters at Charlotte, South Carolina.

C. J. Moore has been appointed to the newly created position of general sales and marketing manager of Exide Industrial Division. The **Electric Storage Battery Co.** Moore, who has been Exide's sales manager for the past five years, thus assumes direct responsibility for all national sales and marketing activities for Exide industrial batteries, battery charging equipment and related components.

He continues to make his headquarters at the new divisional offices at Exide's largest plant in Philadelphia.

Joining Exide in 1935, Moore began as a salesman in the Pittsburgh branch. In 1941, he was transferred to company headquarters as supervisor of motive power sales. He returned to Pittsburgh in 1946 as assistant branch manager and became branch manager there in 1947. He again was transferred to Philadelphia in 1949 as manager of the railway and motive power sales division.

D. Russell Gochnour, director of employee relations for the **Marion Power Shovel Co.**, was recently elected a member of the administrative council of the National Foundry Association. The 24 members of the administrative council represent the foundry industry on a geographical basis. Gochnour, who has been active in the organization since 1951, was elected to a three-yr term.

CATALOGS & BULLETINS

MOTORIZED GEAR DRIVES. *Louis Allis Co., 427 E. Stewart St., Milwaukee 1, Wis.* Bulletin No. 2350 describes the Line-A-Spede motorized gear drives. These drives are gear reducers powered by standard NEMA frame motors mounted on a shelf attached to the reducer. The bulletin illustrates how the Line-A-Spede facilitates standardization of motors to reduce inventory and permits rapid motors changes. Construction features are illustrated in a cutaway, and engineering specifications and dimensions are given. The Line-A-Spede utilizes double, triple and quadruple reduction units for ratios up to 1487 to 1 with motor ratings of 1 to 75 hp. The drives are powered by motors of all types and enclosures, and can be mounted in any position.

ALLOYS AND FLUXES FOR USE ON COPPER. *All-State Welding Alloys Co., Inc., White Plains, N. Y.* A pocket folder of "how-to-do-it-on-copper-information" for welding and maintenance department personnel answers users questions with regard to the increasing number of problem-solving alloys and fluxes All-State Welding Alloys offers for work on copper and copper-bearing alloys in maintenance, production and installation.

HYDRAULIC COMPONENTS FOR MOBILE EQUIPMENT. *Parker Hydraulic Division, Parker-Hannifin Corp., 17325 Euclid Ave., Cleveland 12, Ohio.* Bulletin 1502 reviews directional control valves, accumulators, cylinders, hose assemblies and tube fittings.

FLOTATION. *Wemco, Division of Western Machinery Co., 650 Fifth St., San Francisco 7, Calif.* Eight-page booklet describes the principles of the flotation process for selectively separating finely divided mineral particles as well as the design, construction and operating characteristics of the WEMCO Fagergren Flotation Cell.

CRADLE IDLER AND BELT CONVEYOR. *McNally Pittsburg Mfg. Corp., Pittsburg, Kans.* Bulletin No. 458 gives complete information on the cradle idler and belt conveyor. This brochure gives a description, photographs, dimensional drawings and capacity tables of the McNally cradle idler, idler H-frames and belt conveyor. Information is given on ground material handling.

(*Continued on next page*)

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AMMETER. *Columbia Electric Mfg. Co., 4519 Hamilton Ave., Cleveland 14, Ohio.* Eight-page catalog gives the company's complete line of Tong Test D-C Ammeters. Bulletin pictorial illustrates eight types of instruments and gives detailed information on the selection, ordering and use of Tong Test Ammeters, said to be the only clamp-type ammeters that measure both a-c and d-c. Bulletin includes prices and shipping weights as well as information on the Columbia Type AC-1 Volt-Ammeter and the Columbia Model UV-1 AC-DC Voltmeter, the latter for measuring voltages to 600 volts a-c or d-c.

SPHERICAL ROLLER BEARINGS. *Torrington Co., Bantam Bearings Division, South Bend 21, Ind.* Catalog No. 258 covers five standard series of self-aligning spherical roller bearings, with bore sizes ranging from 40 through 1060 mm. Complete dimension tables, load ratings expressed as basic dynamic capacity, and line graphs showing modifying speed and life factors help the designer to choose the proper bearing for each application. Nineteen pages are devoted to general engineering information specifically related to spherical roller bearings. A section on typical applications is also included. A copy of Catalog No. 258 may be obtained by writing on your letterhead to The Torrington Co.

PORTABLE BIN UNIT. *Pioneer Engineering, Division of Poor & Co., Inc., 3200 Como Ave., Minneapolis 14, Minn.* Folder describes a line of portable bin units. This unit is intended to increase plant output by eliminating starts and stops while waiting for trucks to pull up to the plant. The basic unit stores six cu yd of material with extensions available to increase capacity to eight or ten yd. Mounted on a pneumatic-tired chassis, and available with either mechanical or electric on-plant power, the portable units are completely independent of the rest of the set-up, according to the bulletin.

SLINGS. *Macwhyte Co., Fabricated Products, Kenosha, Wis.* For the first time, Macwhyte cable-laid "safe-guard" Slings and Macwhyte rope-laid "safe-guard" Slings are completely catalogued. Specifications, load ratings, and standard fittings are now catalogued for sizes ¼ to 1½-in. diam, inclusive. Ask for Macwhyte Safe-Guard Sling Bulletin No. 5886.

TRACTOR SHOVEL FILMS. *Clark Equipment Co., Construction Machinery Division, Pipestone Rd., Benton Harbor, Mich.* Seven 20-minute color sound-slide films teach the care and maintenance of Michigan tractor shovels. Step-by-step procedures are projected slowly frame-by-frame as a long-play record explains the technique. This first series of Michigan service training films cover: Service and Maintenance of the Torque Converter, Service and Maintenance of the Power-Shift Transmission, Service and Maintenance of the Engine, Preventive Maintenance, Trouble Shooting the Transmission and Torque Converter, Tractor Shovel Hydraulics, and The Steering Drive Axle.

CLASSIFYING SYSTEMS. *Buell Engineering Co., Inc., 123 William St., New York, N. Y.* Including two line drawings, two graphs, and two installation photographs, this two-color bulletin explains the general operating characteristics of both the centrifugal and gravitational type classifiers. These classifiers reportedly make use of combinations of aerodynamic forces in ways not hitherto employed in the classification field. Information is given on operation, arrangement, power requirements, construction, and Buell pilot plant facilities.

TRACTOR. *Consumer Relations Department, International Harvester Co., 180 North Michigan Ave., Chicago 1, Ill.* International Harvester's complete line of wheel tractors in six power sizes ranging from 12 to 72.5 hp for commercial and industrial use are fully described in Catalog CR-1374-H.

ELECTRIC SUBMERSIBLE PUMPS. *Stenberg Mfg. Corp., Hoosick Falls, N. Y.* Portable, fully submersible electric Flyght pumps for mining, contracting and general industrial use are described. One of the reported features of these pumps is their ability to handle a high proportion of solids. In addition they reportedly will run for long periods without supervision, and will not suffer damage if allowed to run dry. Folder gives details of capacities, weights, and horsepower.

CEMENT PROCESS CONTROL WITH X-RAYS. *Instrument Division, Philips Electronics, Inc., 750 S. Fulton Ave., Mount Vernon, N. Y.* Entitled "X-rays; New Aid For Cement Process Control," the folder describes how Oro Grande Division of Riverside Cement Co. uses the X-ray spectrograph to analyze raw ball mill products. Illustrated with photos and diagrams, the folder explains basic principles of the X-ray method and gives details on sample preparation. Text also deals with analysis costs and operator training.

TRACKWORK FOR INDUSTRIAL USE. *Department A, American Brake Shoe Co., 530 Fifth Ave., New York 36, N. Y.* The Railroad Products Division of American Brake Shoe Co. has published an eight-page brochure on trackwork designed for mines, mills, and other industries which maintain in-plant rail trackage. The booklet illustrates and lists specifications for turnouts, frogs, guard rails, switch stands, crossings, etc. Also included is a section on ordering.

SHAFT MOUNTED DRIVE. *Falk Corp., Department 255, 3001 W. Canal St., Milwaukee 1, Wis.* Bulletin 7100 describes the Falk 315GJ all-steel shaft mounted drive, with increased torque rating of 41,000 lb-in. at the low speed shaft. With a ratio of 25:1, this unit covers a range of applications from three hp at five rpm to 30 hp at 50 rpm. Brochure contains detailed information on selection, dimensions and applications.

Index to Advertisers

ENEMY OF WEAR,
DOWN TIME AND WASTE
AT BUCKHORN MINE

Processing plant of Bell & Zoller's Buckhorn Mine, Johnston City, Illinois uses STANOLITH Grease MP.

STANOLITH
GREASE MP

Situation: As with every underground mine, equipment at Buckhorn Mine is susceptible to wear unless moving parts are protected with a grease film that stays in place regardless of heat, water or dirt.

What was done: Buckhorn Mine management knew where to turn for assistance on lubrication and experienced advice on how to protect equipment from wear. They called on Standard Oil mine lubrication specialist Hervie Dillingham. Hervie recommended STANOLITH Grease MP. This lithium grease is particularly suited to mine lubrication jobs because of its (1) ability to shield parts from grit and dirt, (2) resistance to both high and low temperatures and (3) resistance to water wash out. STANOLITH Grease MP holds its consistency even under the severe working conditions encountered in the lubrication of mine equipment. With its ability to provide lubrication over a wide range of applications, fewer greases need to be inventoried. One drum of grease instead of many different ones reduces costs, saves handling on the job, eliminates application mistakes.

You've got to get down there to see the problem. Standard's Hervie Dillingham does just that. Hervie has experience and training to know what's needed. He has been providing technical service to mines for more than 20 years.

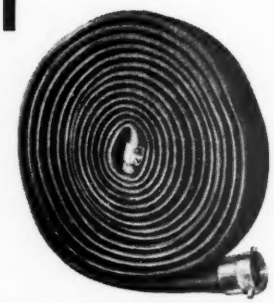
What you can do: Let a Standard Oil lubrication specialist help you find ways to eliminate your lubrication problems. One of these men is on the staff of each of the 48 district offices in any of the 15 Midwest and Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

Quick facts about
STANOLITH Grease MP

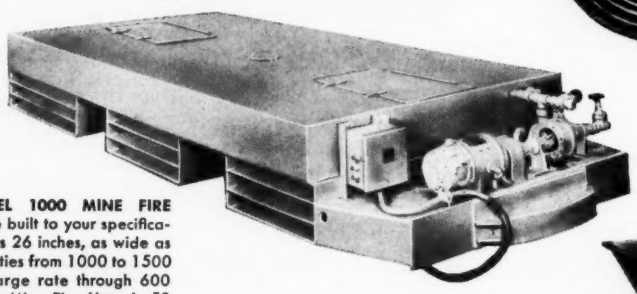
- Capable of providing superior lubrication over a wide range of applications
- Water resistant
- High temperature resistant
- Pumpable in grease gun or pressure system
- Mechanically stable

YOU EXPECT MORE FROM STANDARD *AND YOU GET IT!*

THESE MSA PRODUCTS HELP YOU FIGHT MINE FIRES INSTANTLY

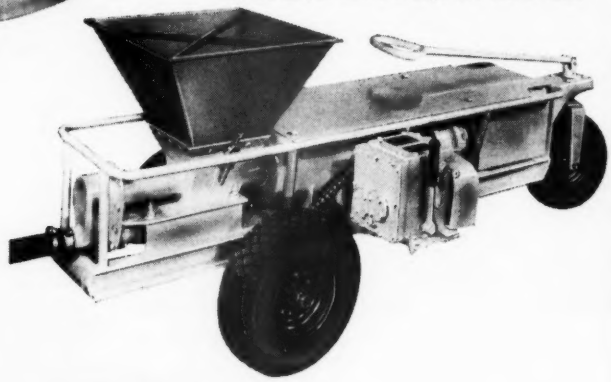


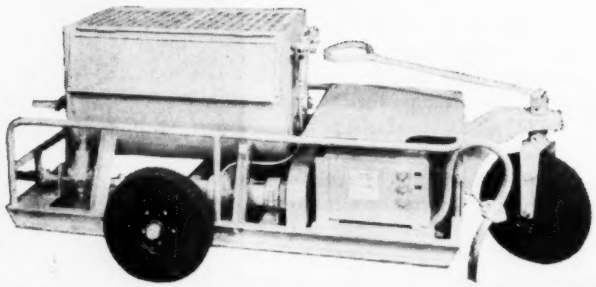
M-S-A MINE FIRE HOSE is especially designed for rugged mine use. It's impervious to rot and vermin. Never needs drying. Lightweight. Easy to handle. Dated and branded for your protection.



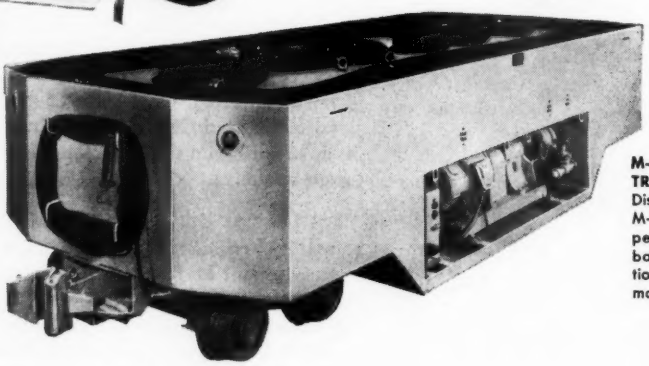
M-S-A BANTAM 400 ROCKDUST DISTRIBUTOR applies rockdust wet or dry. Availability of this machine in the working place, and the men's familiarity with its operation, make it ideal for fighting fires at their inception. Discharges dry dust through as much as 400 feet of hose at an average of 30 lb. per minute. Discharges wet dust at a rate of 50 lb. per minute through 150 feet of hose.

M-S-A MODEL 1000 MINE FIRE TRUCK can be built to your specifications: as low as 26 inches, as wide as 7 feet. Capacities from 1000 to 1500 gallons. Discharge rate through 600 feet of M-S-A Mine Fire Hose is 50 gallons per minute at 50 psi.





M-S-A SLURRY ROCK DUST DISTRIBUTOR can pump a slurry of rockdust and water—the cheapest fire-fighting agents for mine fires—through as much as 1000 feet of hose at the rate of 120 lb. per minute.



M-S-A MODEL 2100 MINE FIRE TRUCK has 2100-gallon capacity. Discharge rate through 600 ft. of M-S-A Mine Fire Hose is 91 gallons per minute at 150 psi. Tank is fully baffled with triple weld construction. Truck is designed for easy maneuverability.

Any delay in fighting a fire may prove disastrous. Often, the sealing of an entire mine or section results. Such an operation is not only hazardous. It's costly.

This threat to human lives and vital mining equipment, however, can be greatly reduced. You can do it with one or more of the indispensable items described above.

A minimum investment in MSA fire-fighting equipment *now*, may save you thousands of dollars later. Write us for helpful literature.

MSA®
SAFETY EQUIPMENT HEADQUARTERS

MINE SAFETY APPLIANCES COMPANY
201 North Braddock Avenue, Pittsburgh 8, Pennsylvania

MINE SAFETY APPLIANCES CO. OF CANADA, LIMITED
Toronto, Calgary, Edmonton, Montreal, Sydney, Vancouver, Winnipeg